MECHANICAL ENGINEERING

January 1961

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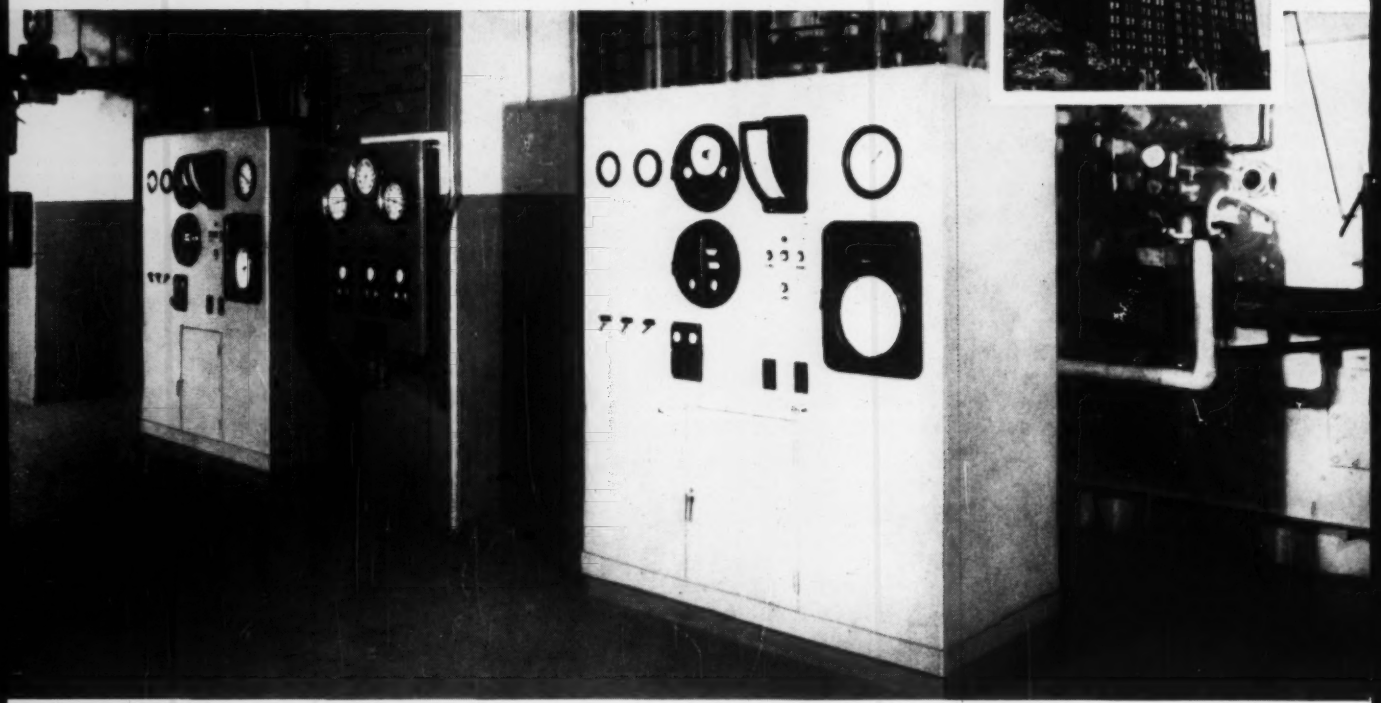
The ASME President... William H. Byrne

New B&W Boilers Cut Heating Costs 22% for Country's 3rd Largest Building



American Furniture Mart Corporation replaces 3 previous boilers with 2 B&W package units . . . Heats 29 Million cubic feet at fuel cost saving of 22%

The American Furniture Mart dominating Chicago's skyline with a 17 story building topped by a 33 story tower . . . has 29 million cubic feet of space to be heated. It is the largest commercial building in the world devoted to a single industry, home furnishings. Throughout the year, it is the national purchasing center for thousands of retail stores, large and small, and at peak markets, upwards of 45,000 buyers and sellers shop its display spaces. The recent installation of two B&W boilers . . . in place of three previous units . . . provides all the steam necessary for this large heating job at a fuel cost saving of 22%. Additional economies can be realized because fuels can be switched in a matter of minutes to use the fuel most economical at any given time. Moreover, these new boilers are fast steaming . . . put out plenty of heat in a hurry even after being turned off all night.

In addition to cutting fuel costs, a savings that will pay for the units in five years, these B&W package boilers cut space requirements in half and require fewer men to keep them in operation. It is interesting to note, too, that these boilers were installed during the height of the heating season . . . with minimum loss of heat to the building's occupants during the changeover period. Furthermore, management knows that any time in the life of the boiler—10, 20 or 30 years hence—B&W's nation-wide service organization will be promptly and economically available if needed.

Providing the efficiency, economy, and service necessary to heat the country's third largest building economically is further evidence-in-action of dependable steam generation by B&W. Whatever your steam requirement . . . whatever your most economical fuel . . . B&W has the boiler best suited to your heating application. For information, contact your local B&W representative. He has all the facts on your area. The Babcock & Wilcox Company, Boiler Division, Barberton, Ohio.

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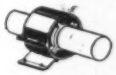

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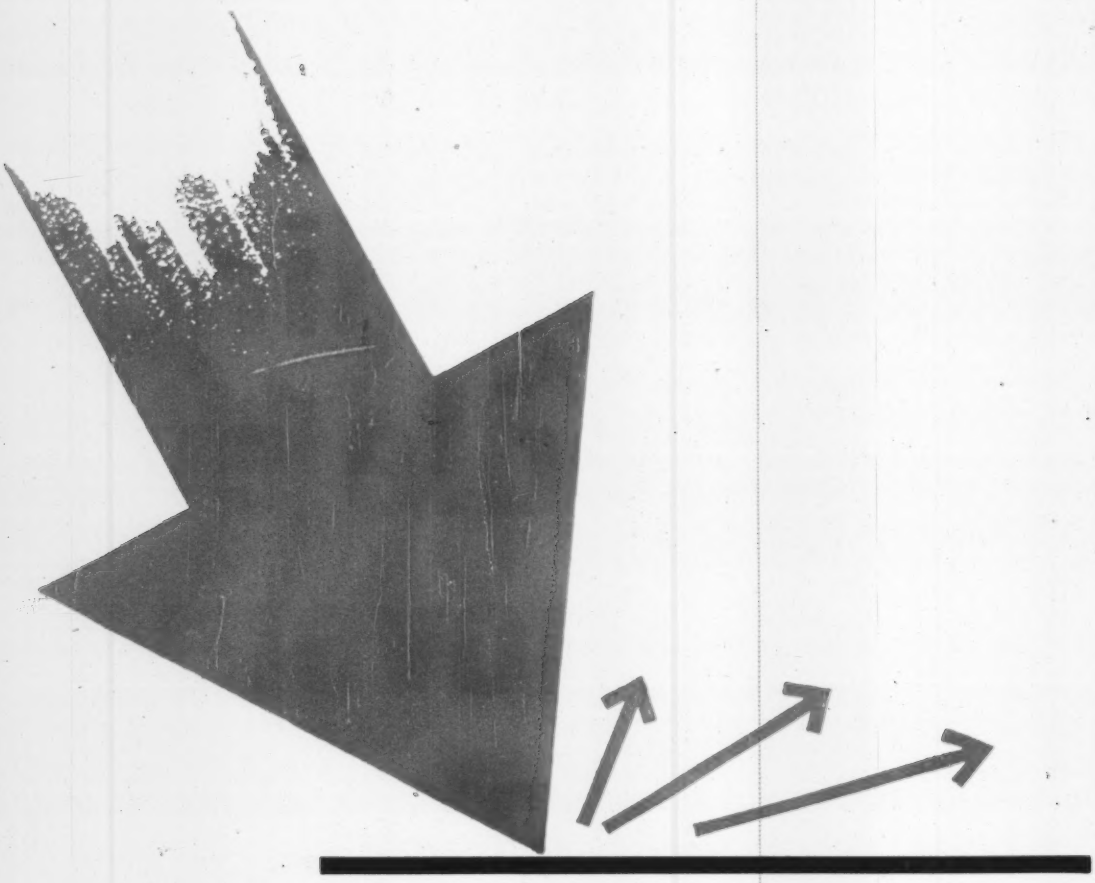

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MECHANICAL ENGINEERING

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VOLUME 83 • NUMBER 1 • JANUARY, 1961

THE COVER

Each year for more than three quarters of a century, your Society has inaugurated a new President at the Annual Meeting (now called the Winter Annual Meeting). President for 1961, William H. Byrne, is the last to be installed at the turn of the year. With the new administrative year, Presidents will take office in June. Thus, Mr. Byrne, one of the country's leading professional engineers and ASME's 80th President, will have an 18-month term of office. For a profile of President Byrne, see the Editorial, pp. 21–22.

MEMO: ENERGY FOR TRANSPORTATION..G. B. Warren and D. H. Brown 23

Hold tight: Automatic trains, electric automobiles, U-drive taxis, moving sidewalks, missile express—they're coming. What forms of propulsion are indicated, and where will the energy come from?

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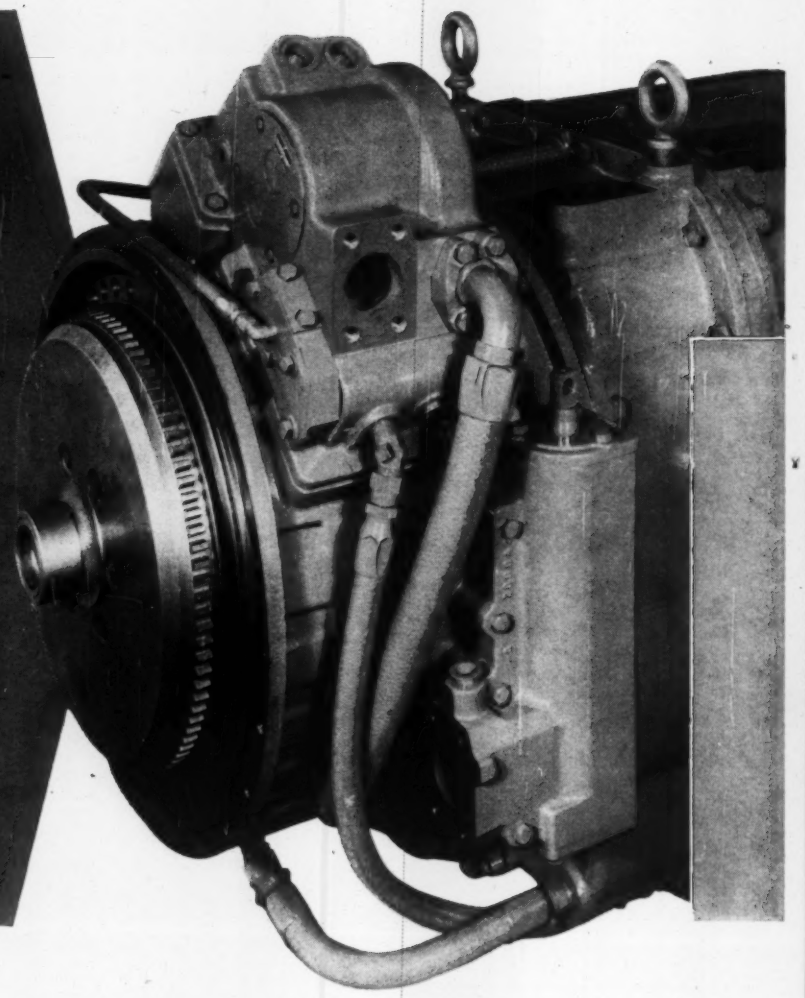
NEW Torque Converter and Constant-Mesh Transmission



Designed SPECIFICALLY for

TWIN DISC, which introduced America's first torque converter in 1936, has a wealth of experience in designing converters for such applications as construction machines, oil rigs and logging equipment. But in designing the 18″ converter for a new power-shift transmission package for heavy-duty vehicles, Twin Disc engineers had to solve a number of special problems.

There are long stretches when a truck does not require torque multiplication. For peak efficiency during these periods, Twin Disc has included a freewheeled stator in its new single-stage converter. When the need for torque multiplication falls off, the speed of the pump wheel approaches that of the turbine. This reduces the reaction force on the stator to the point where it freewheels. The converter becomes in effect a fluid coupling, and the result is higher efficiency.

This efficiency can be stepped up still further under 1:1 ratio conditions by means of a front-end lock-up clutch on the converter. Engagement of this clutch provides direct drive performance.

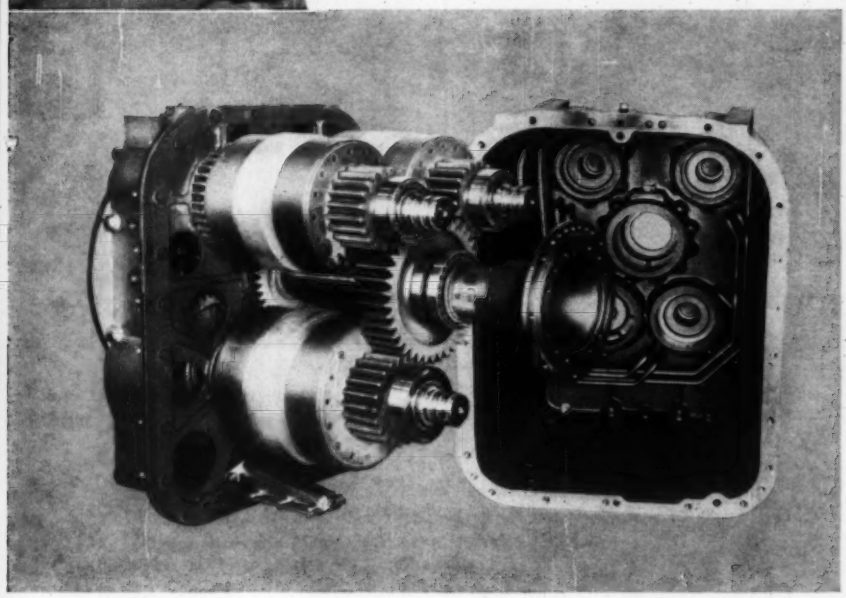
Also featured in this new converter is a hydraulic retarder. Loads on truck service brakes keep going up, yet their capacity is limited by the available brake space at the wheels. The hydraulic retarder absorbs a high percentage of the vehicle's kinetic energy, dissipating it in heat. This saves wear on the brakes and permits safe, controlled descents at higher speeds.

The torque converter can be supplied as a separate unit or as part of a converter-transmission package with the new Twin Disc TA-51-2000 Power-Shift Transmission. This transmission permits gear-shifting on up-hill hauls without power interruption or loss of momentum.

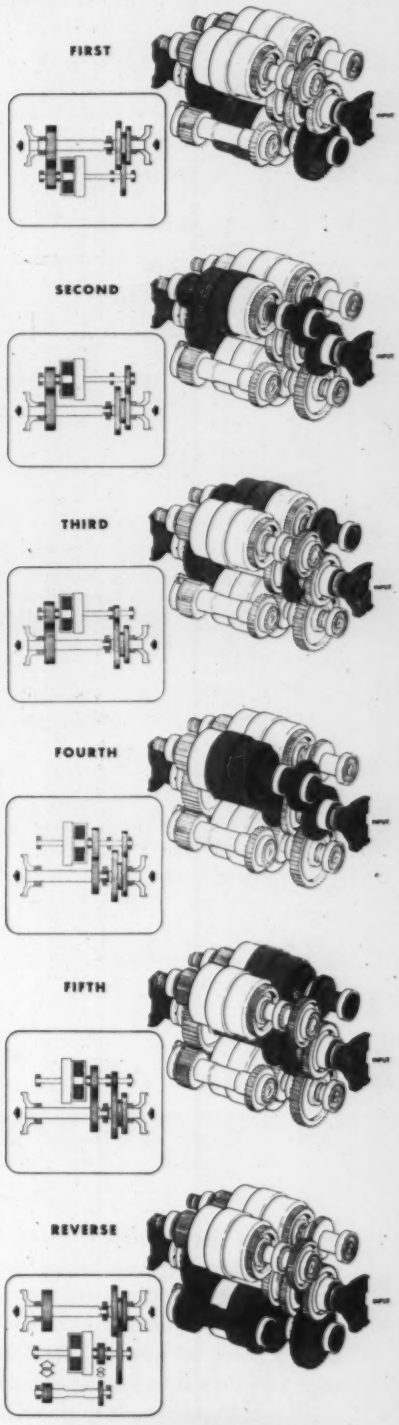
The TA-51-2000 is a straight-through countershaft unit with constant-mesh gearing. Shifting in all ranges at full engine power is

Three models available in the TA-51-2000 Series

Model No.	Max. HP	Max. Torque (lb.-ft.)	Max. Speed (rpm)	Ratio Spread
TA-51-2001	420	1050	2500	5.93:1
TA-51-2002	420	1050	2200	6.80:1
TA-51-2003	420	1050	2800	5.45:1



Transmission Power Flow



Vehicles...by TWIN DISC

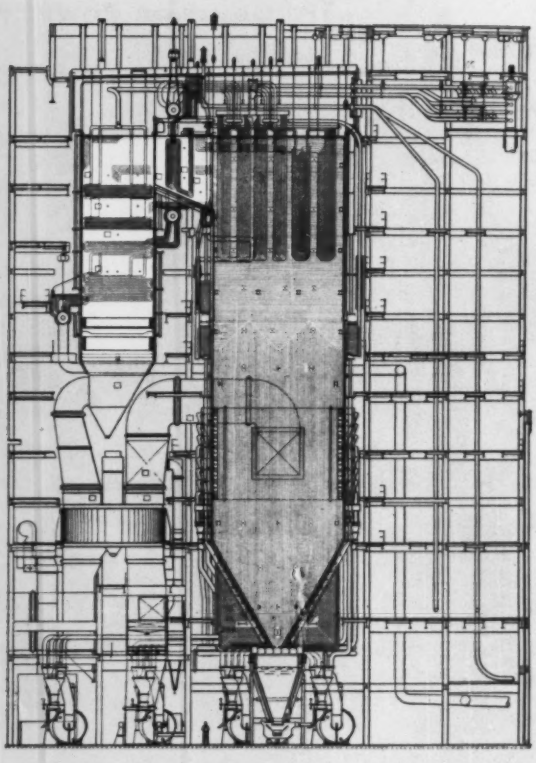
through multiple-disc, oil-cooled, hydraulically actuated clutches. There are five forward ratios and one reverse. A modified version, called the TA-33-1600, has three forward and three reverse speeds. Four different drop boxes are available to meet special drive requirements.

The converter is used only in the first two ranges to get the load moving or to meet low-speed tractive-effort demands. The second ratio has two selector positions, one for drive through the converter and the other for use when the converter is locked up. Lock-up range thus extends from the second through the fifth ratio. Where desirable, a manual over-ride can be provided to permit converter drive in all ranges.

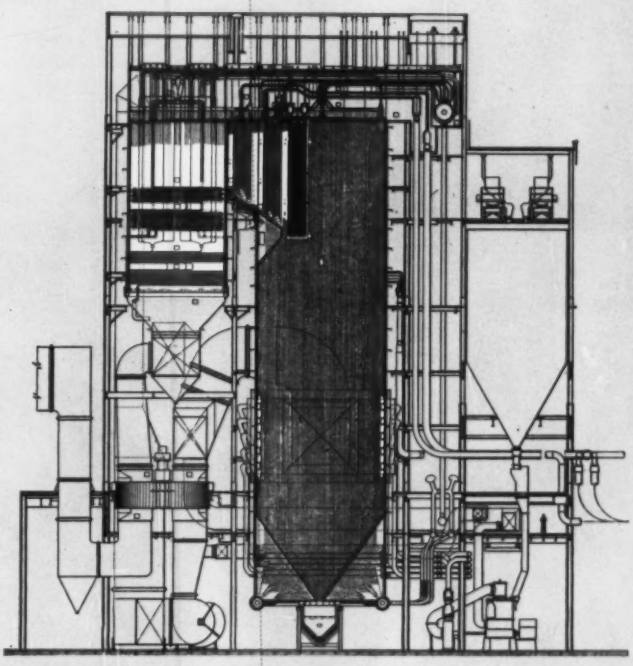
A noteworthy feature of these converter-transmission packages is interchangeability of parts. Gearing can be easily changed to match engine modifications, thereby simplifying inventories and service.

Twin Disc Clutch Company, Racine, Wisconsin; Hydraulic Division, Rockford, Illinois.

ENGINE TO AXLE WITH... TWIN DISC POWER TRANSMISSION EQUIPMENT



The unit pictured here represents the most advanced power plant cycle yet attempted. This boiler, a C-E Sulzer Monotube Steam Generator, is designed to deliver 1200 F steam at a pressure of 5000 psi to a 325-megawatt turbine-generator. The unit employs a double reheat cycle (1050 F—1050 F) and has a primary steam flow of 2,000,000 lb per hr. It went on the line in February, 1960.



This boiler, a C-E Controlled Circulation unit, serves the world's first 500-megawatt turbine-generator. Designed for a primary steam flow of 3,850,000 lb per hr, it delivers 1050 F steam (1000 F reheat) at 2450 psi. It was placed in service in 1960.

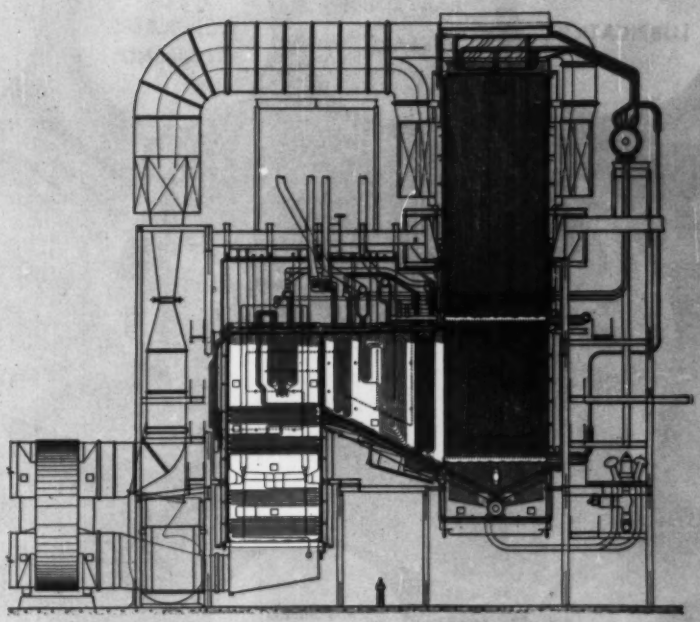
PROFILES

In 1950, a decade ago, Combustion installed some 40 utility boilers, representative of the complete range of power practice at that time. The average turbine capacity was 50 megawatts . . . the largest, 120 mw. All boilers were of natural circulation design, only two used reheat, only two had design pressures as high as 1800 psi. By contrasting these statistics with those of the boilers shown above, the length of the strides taken in the last ten years can be more fully appreciated.

A broader picture of current practice is revealed by the following data relative to 1960 C-E utility installations, which will serve nearly 4,000 mw of new capacity. Six of these boilers will power turbines of 225 mw and above, the largest serving a 500-mw turbine. All but two are designed for pressures in excess of 1800 psi . . . all employ reheat . . . about 60 per cent are of Controlled Circulation design. More than 70 per cent of the units serve turbines with capacities from 150 mw up. In fact, the average unit size is more than three times that of ten years ago, and the largest has

ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT; NUCLEAR REACTORS;

Shown here are three C-E boilers, each of which represents an advanced design concept. Their major points of difference concern capacities, cycles, configurations — considerations of major import in the industry's continuing effort to keep power costs down. As indicated by the picture captions, one unit (far left) is the world's highest pressure boiler and represents the most advanced and efficient cycle yet attempted in power plant practice. Another (left) is the world's largest boiler, serving the first 500-megawatt turbine-generator to go into service. Both of these units went "on the line" in 1960. Although different in design, both follow the same general pattern which has long been characteristic of large C-E utility boilers. The third boiler (right) represents a marked departure from this classic arrangement. Because of the flexibility of its C-E Controlled Circulation design, heating surface can be placed in almost any desired position. Thus, it becomes possible to effect sizable savings in structural steel, stairs, platforms, piping, earthquake-proofing, as well as in the boiler itself.



This new look, made possible by the flexibility inherent in C-E Controlled Circulation design, holds much promise of bringing new first-cost economies to power plant practice. This reheat boiler is designed to deliver 1050 F steam (1000 F reheat) at 2400 psi to a 300-megawatt turbine-generator. It has a primary steam flow of 2,305,000 lb per hr.

# of Power Progress

over four times the capacity of the biggest unit of 1950.

During the last decade, the vocabulary of the power plant has been enlarged with the addition of such words and phrases as "skin casing," "divided furnaces," "twin furnaces," "panel wall," "welded wall," "subcritical," "supercritical," "platens," "pressurization." They account, in large measure, for the fact that, while generating costs have risen considerably over the last ten years, the average net production cost per kw-hr is substantially less today than it was in 1950.

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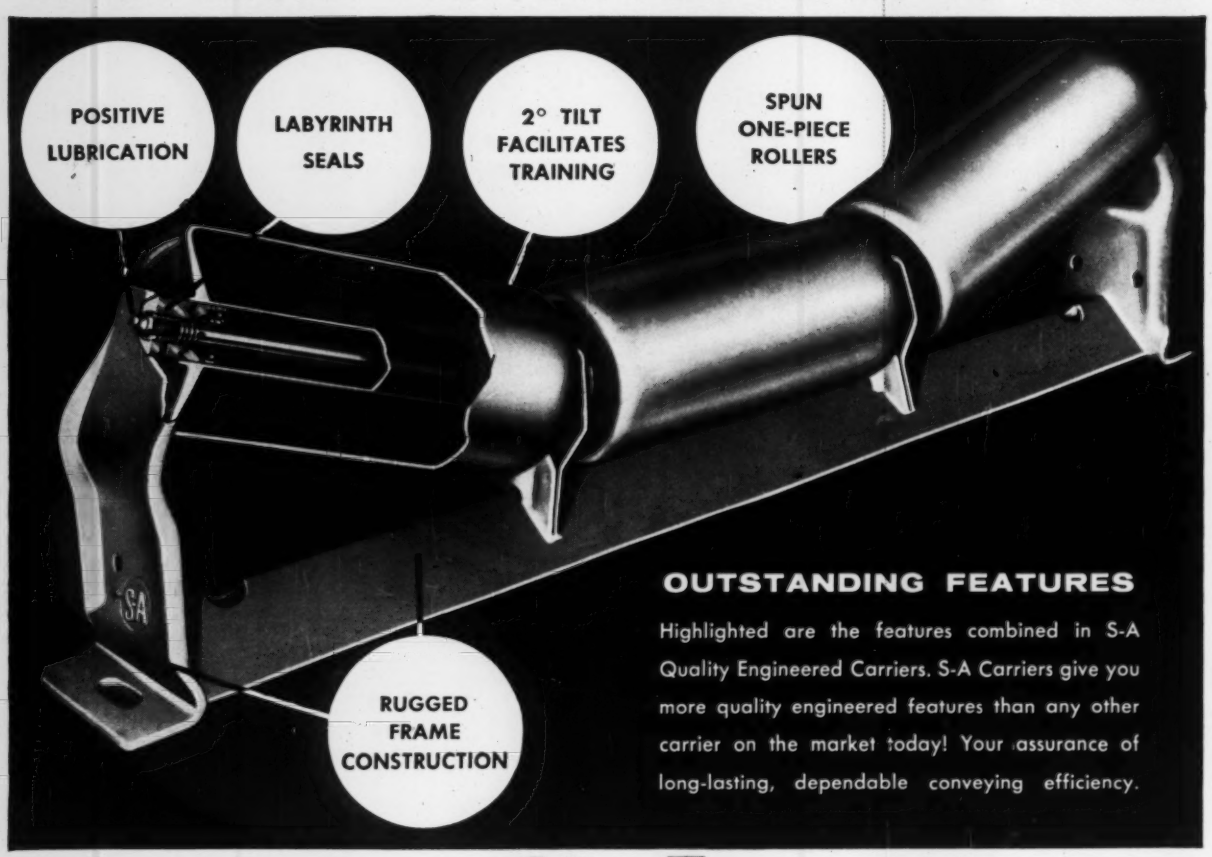

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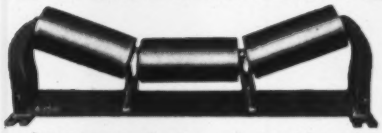

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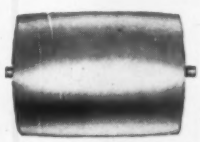

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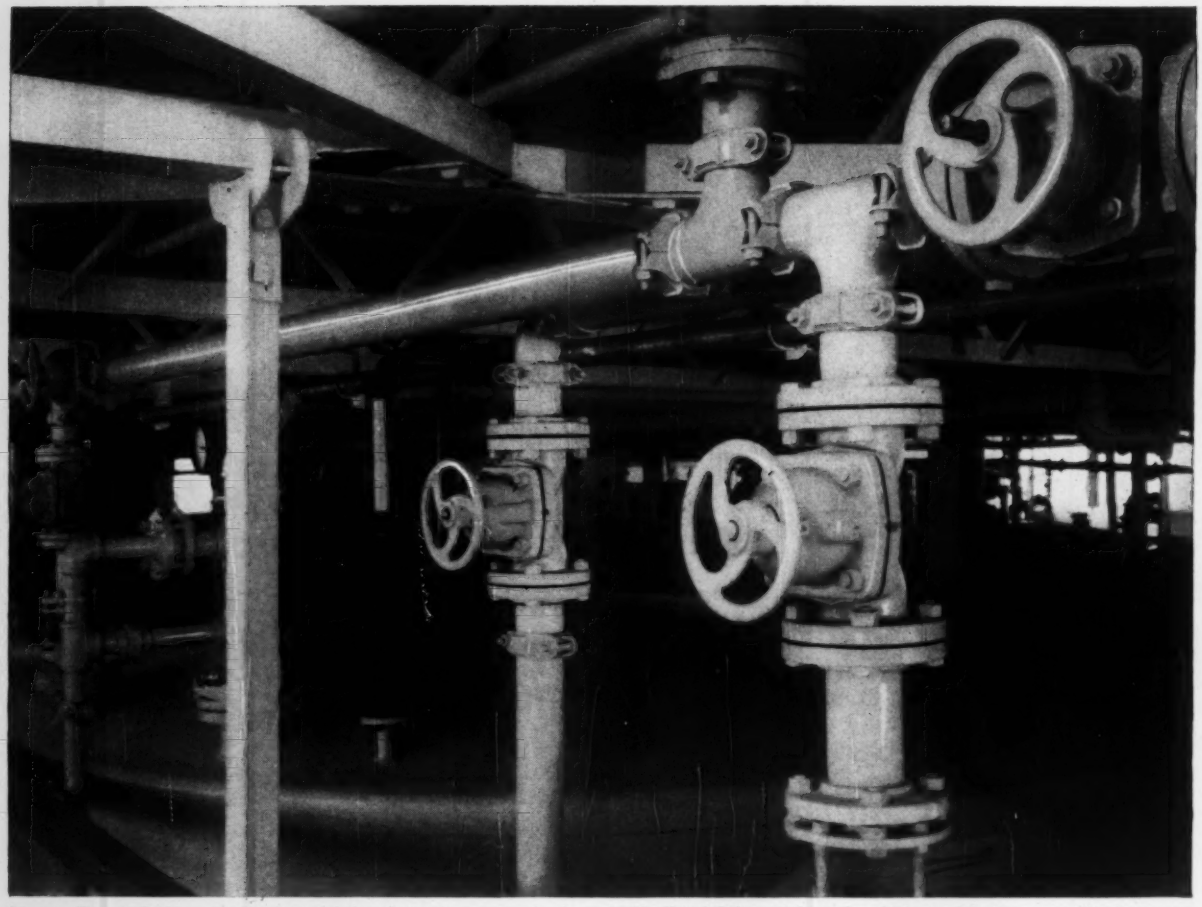


At new Dewey & Almy latex plant, piping into storage tanks has plastic-lined Grinnell-Saunders Valves with neoprene diaphragms.

At Dewey & Almy plant . . .

Grinnell-Saunders Diaphragm Valves guard against plugging, corrosion, contamination

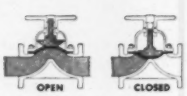
The new Owensboro, Kentucky plant of Dewey and Almy Chemical Division, W. R. Grace & Co., makes polyvinyl acetate emulsions and butadiene-styrene co-polymers for adhesives, paper coatings, emulsion paints and other products.

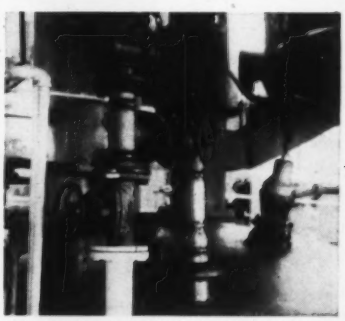
These co-polymers present several manufacturing problems: build-up of obstructions that plug lines, high viscosity that needs wide-open lines, easy hardening by the air.

Selected to handle this tough job: *Grinnell-Saunders Diaphragm Valves.* These rugged valves have a diaphragm that lifts high for streamline flow; seals tight for positive closure. Bonnet mechanism is completely isolated from material in the line by the diaphragm to prevent corrosion and contamination.

What's more, Grinnell-Saunders Diaphragm Valves give smooth passage of material . . . eliminate trapping of solids, reduce frictional resistance. You can choose from a number of body, lining and diaphragm materials.

Find out how Grinnell-Saunders Diaphragm Valves can help *your* installation. Write Grinnell Company, Providence 1, R. I.





Grinnell-Saunders Valves with stainless steel bodies and teflon diaphragms were specified for the reflux lines of this co-polymer reactor.

GRINNELL-SAUNDERS DIAPHRAGM VALVES

GRINNELL COMPANY, PROVIDENCE 1, R. I. • BRANCH WAREHOUSES AND DISTRIBUTORS FROM COAST TO COAST
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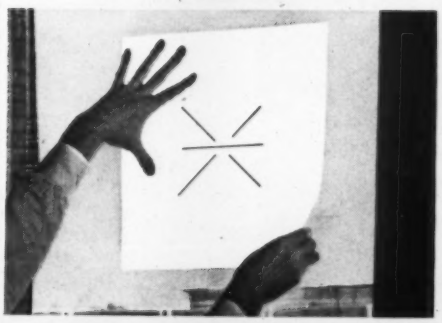

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HOW TO AVOID DEVELOPING A COMPULSIVE DESIRE FOR A DIGITAL COMPUTER

The computer we're warning you about is called Recomp. It looks innocent enough at first. Yet one glance can be enough to arouse your acquisitive instincts. Recomp is a handsome piece of equipment. Like fine architecture or jet plane design, it looks right because it is right; form fits function.

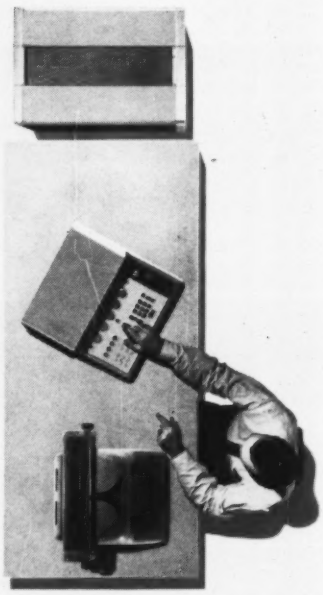
Something else that will appeal to your practical sense is the compact size of Recomp. It's solid state, of course; in fact, it was the first fully transistorized computer on the market. There are no voluminous rows of vacuum tubes; no ventilating problems. Yet many times Recomp can match the performance of computers that literally fill rooms.

Now, to indulge your natural desire to find out more about the finest computer in its class, just imagine you have a Recomp handy. First, plug it in; any wall socket will do, and it takes no more electricity than an ordinary electric toaster. After an appreciative look at that distinctive keyboard, try a few sample problems. You will have a full scale compiler named SALT (that's Recomp's own Symbolic Algebraic Language Translator) to help you, or you can use Recomp machine language which is the simplest of any computer on the market today. If you do not know how to operate the keyboard, never mind; in a few hours you can become an expert at programming Recomp. It doesn't even demand specialized talents; anyone with computer problems can be taught to do it.

While you're enjoying yourself at the keyboard, why not try a problem using floating point arithmetic? Of course, Recomp has it built-in; in fact Recomp is the only compact computer on the market today in which this is a standard feature. It is rather astonishing how much greater capacity this gives you to handle a wide range of problems. Cuts down on that frustrated feeling.

If, at this stage, you can already feel the first stirrings of an irresistible urge to possess Recomp for your very own, let us counsel you: this is just a premature impulse. First you should read this unembellished list of facts:

1] Exclusive built-in floating point arithmetic.



2] Easy to program.

3] Efficient programming; 49 basic instructions expandable to 72.

4] Fast access time due to high-speed loops.

5] Magnetic disk memory with large capacity—up to 8192 instructions.

6] Large word length of 40 binary bits.

7] Each word contains two instructions.

8] Solid-state reliability.

9] Built-in square root command.

10] Large sub-routine and program library.

11] Active users group.

12] Built-in automatic conversion from decimal to binary.

13] Visual display of any word in memory.

14] Simple correction of errors.

15] Easily installed anywhere.

16] Can use conventional teletype equipment.

17] Low cost per computation.

18] High-speed input and output.

19] Programming training provided.

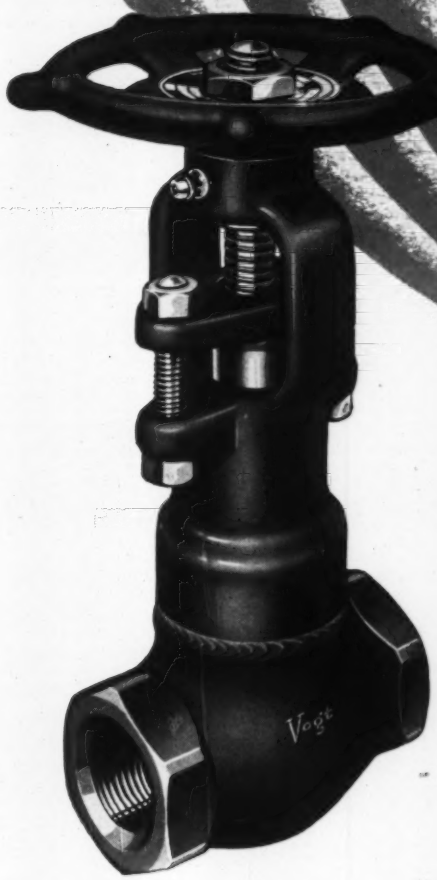
20] Large program exchange.

21] Coast-to-coast sales & service.

No doubt you have read of other computers that claim many of these advantages, but you see, Recomp is the only one that can claim them all. This can be very disquieting when you think about it.

Now, as to how you can avoid developing a compulsive desire for a digital computer: don't see Recomp in action. For on seeing the performance of Recomp, it is quite likely you will insist on owning one. However, if you find that the insidious Recomp has made an ineradicable impression on you, it would be as well to face facts. The truth is, you need Recomp. We'll be glad to help. Our address is AUTONETICS INDUSTRIAL PRODUCTS, Dept. 017, 3400 E. 70th St., Long Beach, California. The Autonetics Division of North American Aviation, Inc.

Another addition to the Vogt line of TOP QUALITY valves . . .



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WELDED BONNET

GENERAL GP PURPOSE

Gate and Globe
VALVES

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To eliminate forever potential body-bonnet leaks, Vogt engineers have developed these new General Purpose valves with seal welded bonnet joints.

This new addition to the world's most complete line of forged steel valves incorporates all the features of other Vogt GP valves—hard faced seats, hardened stainless steel wedges, drop forged pressure parts, and the numerous other advantages of Vogt's valve line.

The desirable safety feature of a back seat on the stem is retained while still offering the elimination of a possible body-bonnet leak.

Available NOW in both gate and globe types, ¼" thru 2", and in both socket weld and screw ends. These are priced identical to the bolted bonnet GP valves; gate valves the same as Series 12111 and globe valves the same as Series 12141.

Address Dept. 24A-FM for literature

Series 2801 Gate Valve
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Both series identical in dimensions and have 13% chrome stainless steel trim.

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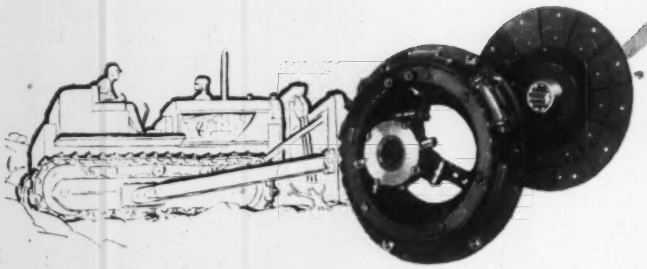
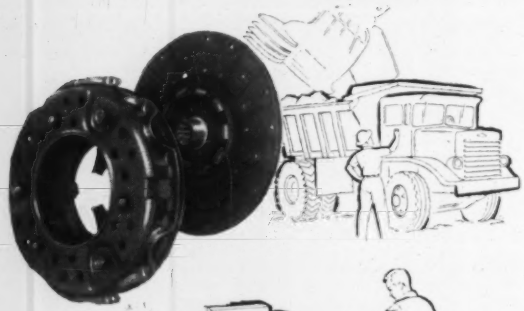
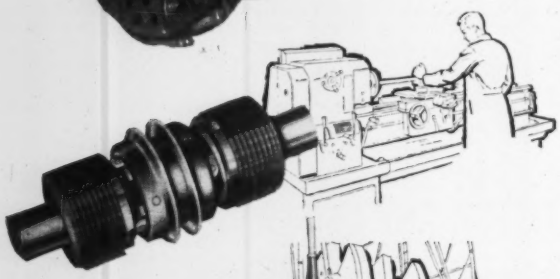
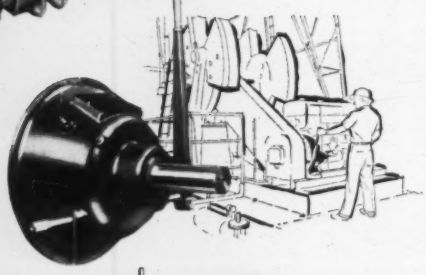
FORGED STEEL
VALVES

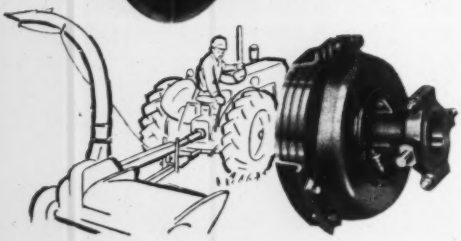
DYNAMIC POWER CONTROL by ROCKFORD CLUTCH











EXTRA THICK FACINGS GIVE LONGER LIFE

Rockford Clutches have maximum thickness facings . . . up to 1/32" more friction material. Only the highest grade materials are used. Rockford's extra long-life facings reduce scoring and greatly cut costs of downtime, replacement and labor.

TORTURE PIT TESTING ASSURES SAFE OPERATION

Torture testing pits burst clutches to bits! At specified intervals, clutches are removed from the production line to undergo severe centrifugal tests. These clutches are spun to destruction but must withstand predetermined high speeds and specified time limits.

STRONG CONSTRUCTION WITHSTANDS RUGGED SERVICE

Corrosion resistant discs are made of high carbon spring steel. Heat treated cast iron improves grain structure of pressure plates. Strong construction is Rockford's key to long and rugged service.

VIBRATION-FREE CLUTCHES OFFER SMOOTHER ENGAGEMENTS

Smooth engaging Rockford Clutches are vibration-free! Rockford Clutch eliminates vibration through dynamic and static balancing. Clutch vibration can ruin bearings and crack housings. Minimum inertias prevent gear clashing and delayed shifting.

PRECISE PRODUCTION MEANS PRECISE PERFORMANCE

Each Rockford Clutch component is precision built. Rotary surface grinding assures uniform thickness. Discs are checked carefully for dish and run-out. Inspectors check close tolerances for flatness by pressure and weight-drop drag machines.

If you need clutches for original equipment or for replacement, Rockford Clutch offers the highest quality in power control. From research to inspection, Rockford Clutches are designed and built for long, rugged and reliable service. Rockford offers an ultra-wide range of power controls for all industries. Write today for illustrated brochure.

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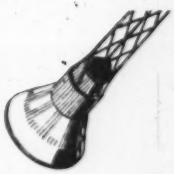
NASA program-highlights

NEXT DECADE IN SPACE

Year 4 to 14 of the Space Age



Project Mercury—U. S.'s first manned satellite.

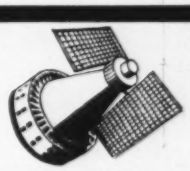
Project Surveyor—First soft landing on moon. Conduct observations from stationary position.

Project Prospector—Soft landing on moon and exploration of area within 50 miles of landing point.

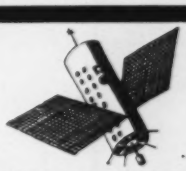
Solar Observatory—350 lb. Large flywheel and extended arms rotate to stabilize. Under construction.

Project Mariner—600 to 1200 lbs. First U. S. Planetary missions to Venus and Mars. Modified craft for hard landings on moon.

Project Voyager—Orbit Mars and Venus and eject instrumented capsule for atmospheric entry and perhaps landing.

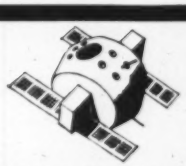


Nimbus—600 to 700 lb. meteorological satellite series. Stabilization system will keep cameras pointed earthward.

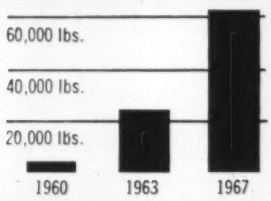


Orbiting Geophysical Observatory—1000 lb. geophysical research satellite designed for a near earth circular polar orbit or an inclined highly elliptical orbit.

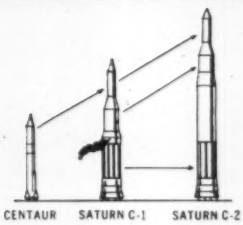
Project Aeros—24-hour stationary weather satellite. Launched in equatorial orbit. Three satellites could permit continuous observation of most of earth's surface.



Orbiting Astronomical Observatory—Standardized, 3500 lb. satellite, for several experiments with different scientific sensors and specialized devices.



Anticipated Growth of NASA Spacecraft in terms of weight of individual near earth satellites.



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NASA Flight Research Center • P.O. Box 273, Edwards, California

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NASA Langley Research Center • Hampton, Virginia

NASA Lewis Research Center • Cleveland 35, Ohio

NASA Marshall Space Flight Center • Huntsville, Alabama

NASA Wallops Station • Wallops Island, Virginia

National Aeronautics and Space Administration

NASA

One of a series.

Why we eliminated the earth's magnetic field... almost

In an isolated laboratory in southwestern Ohio, GM Research scientists have reduced the earth's magnetic field to one ten-thousandth of its usual strength. This is about as weak as the interplanetary field detected by the Pioneer V solar satellite.

Why neutralize the earth's field? To perform with precision one of the more fundamental experiments in magnetism — measuring the Einstein-DeHaas effect. The measurement is simple in concept, experimentally difficult because of the tiny forces involved. It is made by suspending a ferromagnetic rod in a nearly field-free environment . . . magnetizing the rod . . . then measuring the effect (how much the rod rotates) when this known magnetization is reversed.

The beauty of the experiment is that the resulting values can be related directly to the motions of electrons in the rod. The values indicate the large portion of magnetization due to the *spin* of electrons . . . and the slight, but theoretically important, remaining portion due to *orbital* motion of electrons.

These measured values are helping scientists form a better understanding of the perplexing phenomenon — ferromagnetism. Currently being pursued in cooperation with the Charles F. Kettering Foundation, this long-standing project is one of the ventures in basic research of the General Motors Research Laboratories.

General Motors Research Laboratories

Warren, Michigan

Gyromagnetic Ratios		
Iron	***a*** *1.92*	***b*** *1.90*
Cobalt	*1.85*	*1.83*
Nickel	*1.84*	*1.83*
Supermalloy	*1.91*	*1.91*

Comparison of (a) gyromagnetic ratios measured in the new Kettering Magnetics Laboratory with (b) corresponding ferromagnetic resonance measurements. These ratios would equal 2 if magnetization were due only to electron spin, or 1 if due only to orbital electron motion.

System of Helmholtz coils used to neutralize earth's magnetic field.

WHEN YOU NEED.....

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- Leak-Proof Seal
- Minimum Pressure Drop
- Straight-through full flow
- Valves that cannot wedge or jam
- Self-grinding rotating disc

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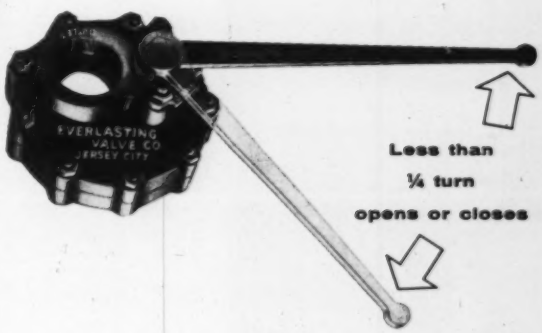

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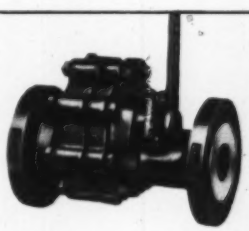
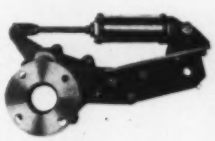
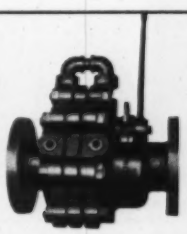
Quick acting, also handwheel operated "Y" and angle types. For pressures up to 600 psi.



GENERAL SERVICE
Where drop-tight seal and full flow is essential.



CYLINDER OPERATED
Can be remotely controlled, electrically or manually.



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Assures free flow of viscous materials.

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For automatic drains or emergency shut off.

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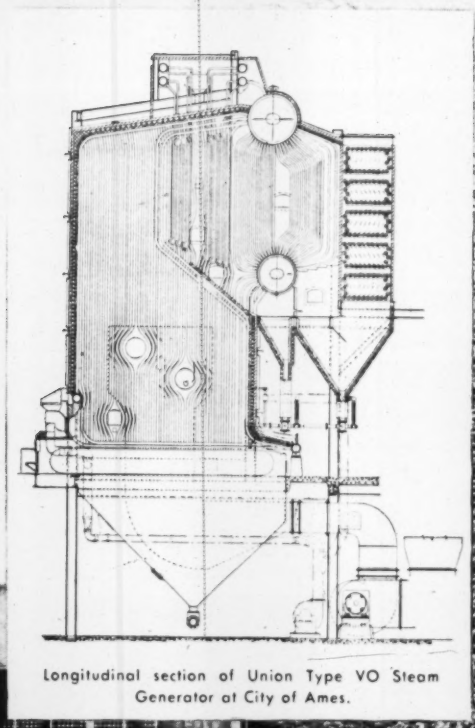
FUEL SAVINGS 16%



Longitudinal section of Union Type VO Steam Generator at City of Ames.

JOB: Includes delivering steam for a 12,650 KW Turbo-generator in Municipal Power Plant, City of Ames, Iowa.

STEAM GENERATOR: A Union Type VO Single-Pass (140,000 lbs./hr., 630 psi, 825° F). Fired by continuous ash discharge spreader stoker. Equipped with extended surface economizer for heat recovery. Selected for its adaptability to multi-fuel firing.

RESULTS: In continuous operation for six months, supplying total steam requirements, the Union VO was credited with fuel savings of 16%.

MORE INFORMATION: Many types and sizes of Union Steam Generators are described in illustrated Bulletin GB-959. Write: Union Iron Works, Division of Riley Stoker Corp., Erie, Pennsylvania.

UNION

steam generators

MECHANICAL ENGINEERING

VOLUME 83 • NUMBER 1 • JANUARY, 1961

Meet Bill Byrne

Editor, J. J. JAKLITSCH, JR.

At a power project in Libya they called him "The Rock." In Cuba, when they weren't shooting at him, he was "The Pipe Smoker." Whether the powerful, heavy-set American defended a beleaguered Cuban power plant, or gave Libyan officials (whom he liked) an occasional blunt "no," he was first and always a mechanical engineer, building machinery or making it go.

The name is Byrne—William Henry Byrne—professional engineer in 45 states, and President of The American Society of Mechanical Engineers for 1961. His career is the American success story of fierce application and tireless work, in the course of which he became an outstanding professional engineer and assembled a supporting structure of two top-flight firms to implement his engineering concepts.

He looks like a man who might have played football in his youth—which he did. Today, his girth is such that he has been getting chuckles with his claim, "biggest man in ASME" (actually, he is 5 ft, 11 in., and weighs 260). He is the Society's eightieth President, and due to a change in ASME's administrative year, he will continue in office until June, 1962. In the years of his association with ASME he has held many posts, including Vice-President of Region II.

He grew up in Region II, in Rockaway Park, on the far perimeter of New York City, the south shore of Long Island. This might account for his passion for fishing, the only activity which can distract him from business. At 14, he became one of the early ham radio operators. At 20 he had built a thriving business, making and selling batteries to the fledgling radio industry.

Where did he get his liking for heavy machinery? What switched him to mechanical engineering? "It was broader," he says, putting together one of his longer sentences. He tries for one word.

The origins of his mechanical bent aren't readily apparent. His father—who at 88 still delights in advising his son on the bookkeeping of the Byrne enterprises—was an accountant and tax expert. Two uncles were New York judges. The pressures on young Bill urged him toward the law.

He would have nothing but engineering, and he entered Stevens Institute in Hoboken. World War I fell across the path, and 17-year-old Byrne had six months in the Army before it ended. While in the Army he saw a battery that he realized would be needed in radio. With another young man he went to work making batteries.

In the postwar depression, Byrne traded his batteries for tubes (then known as "DeForest Audion Bulbs"), tubes for chassis, chassis for complete cabinets—until he struck money. Some of his early customers were DeForest, Hazeltine, Ware, and Pacent, pioneers in radio.

At the age of 21 he received an offer for his share of the business. He sold. He had sensed the trends in radio. He'd noticed that you never went broke taking a profit. Also, his father insisted he complete his education.

William H. Byrne graduated from Polytechnic Institute of Brooklyn in 1923, with an ME degree. Forthwith he took a job with United Electric Light and Power Company, now Consolidated Edison. They put him in the Hell Gate plant. Here were big furnaces and boilers, big machinery, tremendous power. For Byrne, this was it.

ASME President

At one time or another he would be placed in charge of plant operations in many places: But not until the early 1930's, in Cuba, would he have the experience of operating an entire power plant single-handed. At *Compañia Cubana de Electricidad* during the time of the helter-skelter shooting that ended in the rise to power of Batista, the "pipe smoker" arrived at the plant, one bright dawn, to find it had been deserted. But he discovered that enough pressure remained to start up the boilers and the oil pumps. By afternoon he had the plant back on the line with 25 per cent of load.

Over the years, Byrne and his engineering firms have done considerable work in Cuba—until the advent of Castro. But in 1934, his popularity there was not universal. One night, slender little Mrs. Byrne went to close a window, and a bullet took out a chunk of concrete inches above her head. In the months that followed, cutlery and shootlery abounded, but the Byrne luck stood up. He returned to New York and to the career that led to his present status as a professional engineer with a resounding world-wide reputation.

Sales Engineer (Condenser Service Engineering, and Hagan Combustion); Principal Valuation Engineer for the New York State Public Service Commission; independent consulting engineer; consultant and director of the New York City Bureau of Smoke Control (he established the Bureau)—these were some of the steps along the way. His connection with ASME began as far back as 1921, when he was a student member.

Two of his patents cover combustion equipment, one of them the B&B (Byers and Byrne) pulverized-fuel burner, which was bought by The Babcock & Wilcox Company. On one occasion, when his firm was installing such equipment at Hudson Motors in Detroit, he returned to the Book Cadillac, coal dust from head to foot, and they wouldn't let him in the elevator. How did he reach his room? "Subsidized the hotel detective."

Besides his own consulting business, Byrne is sole owner of Byrne Associates, Inc., and Stevens and Wood, Inc., firms that carry out the work for which he, as an independent engineer, is responsible (you can't practice corporate engineering in New York). The phrase "meet a payroll" is no abstraction to him. He meets them head on. His firms' main office occupies one floor of a downtown New York skyscraper building, and when you pass from Byrne Associates to Stevens and Wood you traverse a corridor called "License Alley" on the walls of which hang Byrne's licenses from the 45 states in which he is a registered professional engineer.

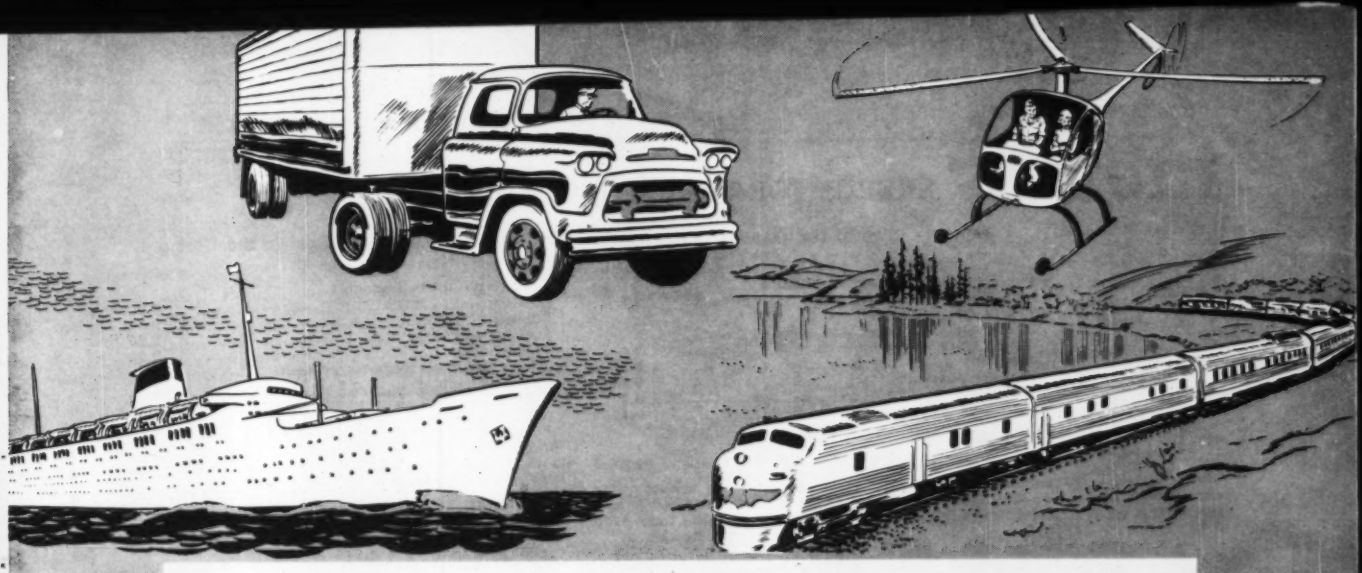
He's a sports fan and a student of military campaigns—and, of course, a fisherman. He's a "Kentucky Colonel." More seriously, he's an 18-hour-a-day man. The 60-year-old entrepreneur of engineering takes his work home and spends the evening dictating into a machine, later unwinding by reading whodunits. Since his "pipe-smoker" days he has adopted cigars for his personal combustion. He fits them into a short, plastic holder. Offer him a cigar that won't fit the holder, and he'll reach into his righthand coat pocket and produce a holder of a different bore. Doesn't fit? No matter. Another pocket, another holder. He'll adapt to that cigar.

He hates to work with his coat on. He hates a clock watcher, never looks at a clock himself, yet never misses a train or plane.

Engineering is a business of making dreams come true, and the new President of ASME has made a vast kaleidoscope of dreams come to life. But has he scored 100 per cent? Is there perhaps one dream that has eluded him? Mr. Byrne pondered this question.

"Security," he said.

He meant it. Still, on the theory that a man always gets the thing he really wants, whether he recognizes it or not, it would seem that security has been a little way down on the Byrne agenda. Ahead of it, surely, was a love of action, a "rage to live." And a passion for engineering. As Vice-President of Region II, he gave at least a third of his time to ASME. Many other engineering societies have had the benefit of his efforts and counsel. The man with the barrel shape and the cigar is all engineer, and he'll pitch for ASME during the next 18 months.—*Maurice Barrangon*



..... memo

ENERGY FOR TRANSPORTATION

TO: **All Mechanical Engineers**

FROM: **Glenn B. Warren,**[1] Past-President, ASME
Dale H. Brown,[2] Mem. ASME, General Electric Company, Schenectady, N. Y.

The National Academy of Sciences – National Research Council recently held its first meeting on a study of the over-all transportation system in this country. A proposed study in depth may lead to important technological, legislative, organization, and management suggestions looking toward an improvement in the effectiveness and efficiency of the transportation system.

Some concept of the magnitude of transportation in comparison to the U. S. economy as a whole was obtained by the approximate figures shown in Table 1. Some of these data came from a statistical analysis prepared by the Academy staff. The figures indicated that transportation costs in this country for both goods and passengers are approximately 20 per cent of the gross national product.

Truck Transportation. In the course of the meeting, it became clear that an over-all survey of the trucking industry is needed. Statistics relative to it other than the "common carrier type" and contract type are apparently not available and are only known on an approximate basis. There are 11 million trucks, 3000 separate companies, 4 million part-time employees, and 7 million full-time employees. One in 10 paychecks go to trucking employees and 35 per cent of all special highway taxes are paid by trucks. Trucking was described as "one means which can take away the lack of flexibility of other forms of transportation."

Although there are 3.4 million miles of roads and streets (1 million unsurfaced) planned, built, and maintained by 35,000 different government units, only $17 million is being spent annually on research on all highway problems — a fraction of 1 per cent.

Railroads. A New York Central spokesman indicated that substitution of new computer techniques for the complicated "way bill" now used would help greatly in handling freight. In motive power, the present diesel locomotive is a major improvement but not the final answer. A 7000-hp or 5000-hp locomotive package would also be a help. The company is doing "in-house" research with a valveless pulsejet gas generator. The unit, at the present time, is supplying hot gas

[1]Vice-President and Consulting Engineer, Turbine Division.
[2]Thermal Power Engineer, General Engineering Laboratory.
Based on an in-plant memo summarizing the NAS-NRC meeting prepared by Mr. Warren for circulation at the General Electric Company. The balance of the article is based on a paper, "Energy for Transportation—Power, Fuels, and Engines," co-authored by Mr. Warren and Mr. Brown.

Table 1 Size of the Transportation in the United States, Based Upon Cost to the User

	$ Billion		$ Billion
Intercity passenger revenue, including railroad, aircraft, bus, and other forms	2.5	Internal city—mass transport	
Intercity freight revenue		Buses	0.9
Roads and railroads	9	Subways	0.25
Motor trucks—common carriers	5	Surface—railroads	0.20
Pipelines	0.75	Trolley coach	0.20
Motor trucks—contract	0.45	Trucking industry, local, short haul, and unscheduled	29
Waterways	0.2	Private motor cars	
Air	0.1	New cars per year	16
Foreign passenger travel, to and from the U.S.	1	Fuel and maintenance on private motor cars	20
United States foreign trade—freight revenue	2.5	Roads	
		Maintenance and new roads, about	15
		TOTAL	103

[a] These figures are all approximate and independent of each other. The amount of tax in each is not known as yet. The authors are inclined to believe that the truck figures may be somewhat too high and the figures relative to private motor cars and roads somewhat low.

for a turbine drive. To date, the unit has successfully burned liquid fuels of both high and low molecular weight. In addition, it has successfully demonstrated its ability to burn powdered solid fuels. In present freight handling, dead weight is 123 per cent of net weight. Fuels are still not satisfactory, although railroads consume 60 per cent of distillate fuels.

Although the number of Chicago, Rock Island, and Pacific Railroad employees has been reduced from 42,000 following World War I to 24,000 in 1951 and 16,000 today, it is handling more business but still suffers from duplicating transportation service—mergers, integration, piggyback, and containerized handling can help. A new freight-car design is needed. Present cost, about $8500, is twice as much as 20 years ago, whereas diesel-locomotive costs have risen only 20 per cent in the same period. They feel suburban passenger business can be made to pay. They regard the fuel cell as the most promising of the new motive-power energy sources.

Some caution was urged in the application of computers by both IBM and Department of Defense spokesmen: (*a*) Do not provide more data than the organization can use; (*b*) by all means arrange for alternate manual operation if you are going to automate by computers, otherwise the failure of one section may throw the entire organization out of operation; (*c*) the "optimum" solution provided by the computer may not be the best if all intangible conditions are taken into consideration—be sure to examine the next best and perhaps third best solutions to see if one of these may not be the best overall.

A representative of the Military Traffic Management Agency, USA, stated that: (*a*) The transportation industry needs a basic revision of the traffic structure; (*b*) it should be based on "straight-line distance" between two points and "cost of service;" (*c*) more multipurpose vehicles must be developed to reduce "empty back hauls."

The Effect of Vehicle Developments on Energy Requirements[a]

The evolutionary and revolutionary forms which transportation may take in the near future will have a great effect upon the means of developing the energy required.

1 Supersonic Flight. The discovery of the "pinch-bottle effect" which reduces the propulsive power required in supersonic flight and development of special high-lift devices for slower take-off and landing should bring the next generation of transport planes into the supersonic regime. *Power:* Various forms of turbine-jet ramjet afterburners for propulsion and turbojet-fan lifting devices for take-off.

2 Fast Water Transportation. Higher speeds over or under water are promised by the "porpoise-skin" method of reducing friction and the hydrofoil method of lifting the hull out of the water. When control problems have been solved the amphibious air-cushion vehicle which travels equally well over land and water and does not require smooth roads may have a profound effect on transportation patterns. *Power:* Internal-combustion or gas-turbine engines.

3 Automatic Trains. After all, an automatically controlled electric train operating on fixed rails ought not to be a more complicated engineering problem than the high-speed automatic passenger elevator. *Power:* Electricity.

4 U-Drive Taxis. Half the taxi fleet of a large city could be drive-it-yourself taxis, unlocked from their parked position by dropping quarters into a parking meter or inserting a credit card. The diversity factor in metropolitan traffic patterns would take care of most of the distribution, although some supervision and return of vehicles to points of heavy traffic origination would be required. *Power:* Gasoline or electricity.

5 Missile Express. Mail, special kinds of goods, and people sent by missile—would have been a fantastic thought 10 years ago but will be practical 10 years from now. Fuel cost of 6 Btu per gross ton mile (in satellites on basis of multipasses around the world) have already been achieved—less than that for any other form of transportation—by traveling above the region of atmospheric drag. Net fuel costs from 5000 to 10,000-mile journeys might not be out of reason. *Power:* Exotic fuels, solid fuels, or as-yet-unknown fuels.

6 Escalators and Moving Sidewalks. Moving belts now widely used for transportation of solid fuel, ore, grain, and other materials will be increasingly used for moving people and baggage. *Power:* Electricity.

New Motive Power Possible With Present Technology

A number of developments in the field of power sources have implications for the various forms of transportation:

1 Ships, Steam. At present 900-psig, 900 to 950-F steam without resuperheat seems to be the maximum economically justifiable for ships. Cost rather than technology is the bar.

[a] The portion of this article based on the paper co-authored by Mr. Warren and Mr. Brown begins here.

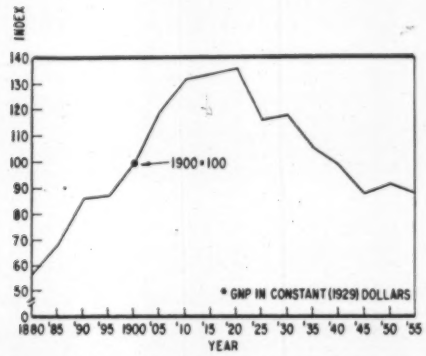


Fig. 1 Energy consumption per unit of gross national product at five-year intervals. Based on preliminary figures from "Energy in the American Economy, 1850–1975," to be published by Resources for the Future, Inc.

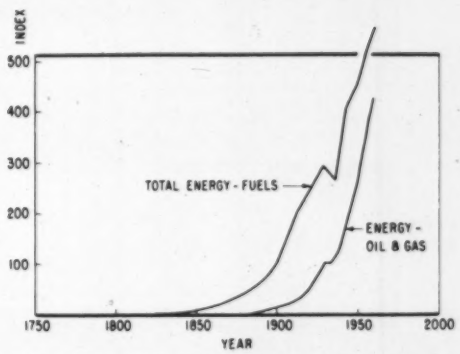


Fig. 2 Fossil-fuel energy production in the U. S. plotted on a long-term basis, indicating an explosive increase in our consumption. The other three-quarters of the world may begin to use energy soon at the same rate of increase.

Gas Turbines. Regenerative open-cycle types are beginning to be applied. The addition of intercooling may further increase economy and capability for a given frame size. Reversibility is still a problem.

Nuclear. Water-cooled reactors and steam turbines will probably be basic for some time, but closed-cycle gas-cooled reactors coupled to closed-cycle gas turbines are being developed.

Propeller Developments. Two concentric opposite-rotating propellers may be used within a few years. These would probably add 6 to 8 per cent to the over-all propulsion efficiency as compared with the single screw now used even up to 25,000 hp or more. Hydrodynamics are more satisfactory than for outboard twin propellers.

2 Pipelines. Automatic operation and greater efficiency —capability has already increased almost 3 to 2—are promised by the intensive development of reciprocating-gas-engine compressor drives and the application of gas-turbine drives. Electric-motor drives are also being applied.

3 Railroads. While the diesel seems to be approaching the limit of economy improvements, gas-turbine developments in all fields will have an effect on railroad use and make the economics of this type of motive power much more favorable in the future. The supply of central-station power available at low cost from high-tension lines adjacent to railroad tracks will increase as the high-tension network expands. If the conversion-technique requirements can be met, the move toward electrification which was unsuccessfully attempted 40 years ago may be resumed.

4 Automotive Propulsion. Reciprocating Engines. A semi-diesel, combining the spark-ignition and compression-ignition principles, may permit a more economical lean-mixture operation of automobiles. Present vehicles are designed primarily for maximum power and high-speed operation. The more efficient combustion would also aid in reducing the smog problem.

Gas Turbine. The 50 to 500-hp gas turbine may find an increasing acceptance for automotive application. The present delayed responsiveness of these turbines, because of the inertia of the gasifier turbine and compressor rotors, may be overcome. Transmission problems are much simpler than for reciprocating engines. Manufacturing cost is the greatest impediment to broader use.

Battery Operation. The prospect of adding some or all of the energy used by motorcars—which is approximately equal to that of all the electrical energy now furnished by central stations—to electric energy demand is intriguing. It is spurring attempts to develop light delivery trucks and family second cars that are electrically operated. Smog elimination is added to the attractiveness of the off-peak demand for recharging. Steady improvements in storage batteries and the breakthrough in solid-state devices for charging and control are adding to the possibilities.

5 Helicopters. Short-distance transfers between airports and cities and goods transportation to otherwise inaccessible locations for high-tension-tower and other construction furnish the impetus for helicopter development. This is really a movable "sky hook" for delivering materials and prefabricated structures. Small gas turbines with high reliability, good fuel economy, and low weight are promising for motive power.

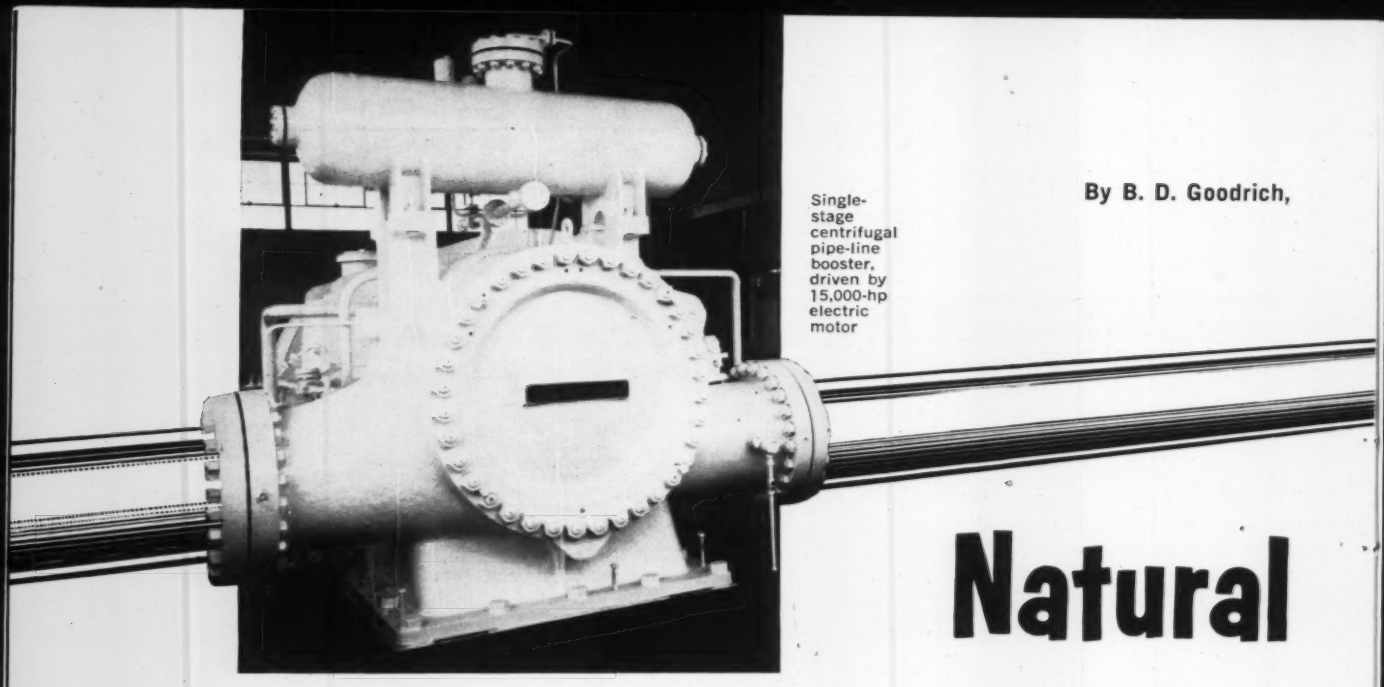
Outlook for Our Energy Supply

Historically, our use of all forms of energy has increased 3 per cent per year and has been compounded over a long period of time. Energy specifically for transportation in the U. S. has increased 5 per cent per year in the same time. Electrical energy has increased at about 7 per cent per year compounded for the past 75 years. The utilization of energy per unit of gross national product, Fig. 1, increased prior to leveling off in 1920 and has now decreased until it is 25 per cent under what it was 40 years ago.

On a long-term basis this continuing compounding of a 3 per cent increase will mean an explosive increase in our consumption of energy. If the rest of the world begins to approach U. S. usage, energy supplies will be rapidly depleted and the cost will rise. Although the depletion of fossil-fuel reserves has been anticipated for some time, by and large the potential future supply has never appeared as favorable as it does today. Proved reserves of oil and gas have continued to increase faster than they have been used. The supply of coal is also ample for some time.

Not only are oil reserves being added but discoveries are being made of ways to leave less oil in the ground by the utilization of more efficient production methods. The use of underground nuclear explosions may also make it possible to tap submarginal oil reserves. Underground gasification may improve coal utilization, although the method is still far from practical.

These factors do not decrease the need to improve utilization efficiency and to conserve irreplaceable stores of fossil fuels. In the longer distant future, fission and fusion power may be applied to meet the growing needs for energy sources.



Single-stage centrifugal pipe-line booster, driven by 15,000-hp electric motor

By B. D. Goodrich,

Natural

TODAY, the natural-gas industry ranks as the fifth largest industry in the nation, in terms of net capital investment. Yet only a few years ago, this industry's future seemed obscure. At best, this industry's prominence was localized near its source, where natural gas was used for domestic heating and electric power generation. Natural gas was a by-product of crude oil production and was considered a nuisance in most cases. It was disposed of by flaring and when it was discovered in large quantities, carbon-black plants were built that squandered this wealth of energy.

Then Came the Pipeline

Then came the modern pipeline, the means of transporting large quantities of natural gas from its source to the areas of its greatest potential use in an efficient and economical manner. In the 1920's, technological advancements were made that paved the way for this modern pipeline. Metallurgical advances had produced steel that would stand stresses of 37,000 psi without yielding, and processes were developed for the manufacture of welded or seamless steel pipe capable of withstanding pressures in excess of 500 psi; mass production of thin-wall, large-diameter, high-strength pipe became practical and economical. Development of electric-arc welding principles and techniques made it possible to join this new kind of pipe in a manner that the joints were actually stronger than the pipe itself.

The improvement of engines for the compressor stations and the development of the ditching machine, and other mechanical equipment needed for pipeline construction, completed the picture and the modern pipeline was a possibility. In 1931, this modern pipeline became a proved reality when The Natural Gas Pipeline Company of America built a system of 24-in-diam pipe that reached for over 1000 miles, from the Texas Panhandle to Chicago.

Even though natural gas could be made available at the customer's doorstep, there was still no increase in the growth rate of the industry. Times were bad, business conditions were depressed, and markets had not been developed. There was opposition from interests of other types of fuel. Then came World War II and a scarcity of materials. Finally the obstacles were removed and the natural-gas industry began to appear as one of the nation's major suppliers of energy, its present prominent position being largely attributable to the modern, long-distance, large-diameter, high-pressure pipeline and transmission system that carries the commodity to the markets in an economical and efficient manner. Over eighty per cent of the natural-gas-pipeline industry, the major phase of the natural-gas industry, has been developed during the amazingly short period of the past 15 or 16 years.

Following World War II, the final factor materialized that released this industry for its spectacular climb to its present prominent place among the major energy suppliers of the nation. This last required ingredient was the need. Industrial activity, already tuned to a high pitch during the manufacture of war-waging materials, was being rapidly applied to the production of consumer goods—consumer goods that had not been replaced during the war years and consumer goods for an elevated standard of living. Domestic fuel demands were stronger than ever before, even acute in some areas, because of the postwar population shift to metropolitan areas. There were growth and adjustment throughout the country and energy was in short supply. As to capital, the known and proved reserves of natural gas provided the financiers with the assurance that the costly gas-pipeline systems were long-term, profitable ventures.

Explosive Growth

By 1948, the gas-pipeline industry was definitely into the period of explosive growth that has brought the natural-gas industry to its present position as fifth largest in the nation. About that time a typical modern pipeline system might extend for more than 1000 miles and operate at a pressure of 800 lb. Its pipe probably had a

Contributed by the Petroleum Division and presented at the Winter Annual Meeting, New York, N. Y., November 27–December 2, 1960, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. ASME Paper No. 60—WA-43.

Senior Vice-President, Texas Eastern Transmission Corporation, Shreveport, La.

Natural gas was practically a waste product until engineers developed the steels and the pumping equipment for pipelines. The industry created has come up fast. What is its future?

Gas—THE PIPELINE INDUSTRY

diam of 24 in., a minimum yield strength of 46,000 or 52,000 psi, and was joined by the electric-arc welding process. The compressor stations were mostly multiple installations of 1000 or 1100-hp reciprocating gas engines, and construction methods had developed into a highly organized and mechanical operation. In 1948, I presented a paper[1] to ASME dealing with the conversion of the Big-Inch and Little Big-Inch war-emergency pipelines to natural-gas service. That paper also discussed the adoption, by Texas Eastern, of the centrifugal compressor for use in this conversion. This was the first time this type of compressor had been used at pressures in excess of 500 psi, and the first time they had been used on a long-distance gas-transmission pipeline system; this was a new type for the gas-pipeline industry.

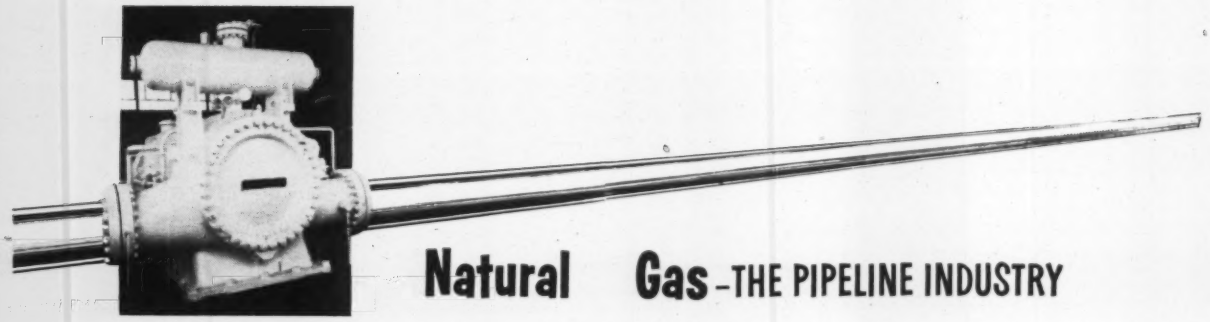
Federal Power Commission Statistical reports for 1948 show that only 26 of the present-day 41 major natural-gas-pipeline companies existed in their present form, and that five of these had been founded recently. These 26 companies operated a total of 42,000 miles of transmission mains in 1948; no storage-field lines are shown for that year. A total of $1^{3}/_{4}$ million hp was installed in 291 compressor stations, along these pipelines, bringing the plant evaluation of these companies to $1.6 billion. That year, the major natural-gas-pipeline companies delivered a total of 2.5 trillion cu ft of gas that was backed by nine trillion cu ft of company-owned reserves. Natural gas provided 15.1 per cent of the nation's energy in 1948.

Of the 26 major gas-pipeline companies that existed in 1948, five of these had been founded since the later days of World War II. These include such well-known names as Tennessee Gas Transmission Co., Michigan-Wisconsin Pipe Line Co., Texas Eastern Transmission Corp., and Texas Gas Transmission Corp. Among the forty-one major gas-pipeline companies existing at the end of 1958 we find 15 that were not there in 1948. Included in these 15 additions to our list we find more familiar names like Transcontinental Gas Pipe Line Corp., Texas Illinois Natural Gas Pipeline Co., Algonquin Gas Transmission Co., Pacific Northwest Pipe Line Corp., Gulf Interstate Gas Co., American Louisiana Pipe Line Co., Trunkline Gas Co., and Permian Basin Pipe Line Co. The plant evaluation of the 15 companies, founded during this ten-year period, now constitutes over 22 per cent of the combined plant worth of all major gas-pipeline companies, and the plant evaluation of the 20 companies formed since the later days of World War II accounts for almost 50 per cent of the present plant worth of all of the major companies existing in 1958. And the list is still growing, with companies like Houston Texas Gas & Oil Corp., and Transwestern Pipeline Co., being formed too recently to have been included in the 1958 listing.

By the end of 1958 the 41 gas-pipeline companies were delivering 11.4 trillion cu ft of gas annually, four and one half times the 1948 quantity. Their combined plant had grown to $8.0 billion, an increase of 400 per cent and the miles of transmission pipelines they operated was over twice the 1948 value. The number of compressor stations in operation in 1958 had increased to 558 and the horsepower installed in these stations had increased to 6.2 million. By 1958, gas reserves had risen to 217 trillion cu ft, a 19-year supply at that year's rate of delivery, and an increase to twentyfour times the 1948 level. Also during this ten-year period, underground storage reservoir capacity increased 600 per cent. And in 1958, natural gas accounted for 26.5 per cent of the energy supplied by all major sources in the U. S. The natural-gas industry almost doubled its relative standing as a supplier of energy during this period, and major gas-pipeline companies handled 83 per cent of all natural-gas deliveries in 1958.

A closer look at these statistics can lead us to conclusions that reflect credit on the manner in which this expansion has been conducted. Even though plant worth of these companies increased to five times the 1948 level during this period, while delivery rates were up $4^{1}/_{2}$ times, the efficient and economical manner in which the industry was expanded and operated is clearly apparent when you consider that this period coincides with one of greatly expanding economy for the whole

[1] B. D. Goodrich, "Conversion of Pipelines From Oil to Gas Transmission," MECHANICAL ENGINEERING, September, 1948, pp. 733–737.



Natural Gas - THE PIPELINE INDUSTRY

country. The rate of increase in gas deliveries was twice the rate of increase of miles of transmission pipelines needed to make these deliveries, indicating use of larger-diameter pipes, higher working pressures, and more efficient and higher load-factor operations. While the number of compressor stations doubled, the horsepower installed in them increased to $3^1/_2$ times its 1948 level, showing larger, and thus more economical, concentrations of power, not only in each location but in larger unit packages as well. The great strides in underground storage capacities and company-owned reserves indicate that the natural-gas-pipeline companies are striving to solidify and extend their position as prominent suppliers of energy.

The Typical Pipeline

A typical modern 1958 pipeline has changed its appearance from that of the 1948 vintage in such a manner as to substantiate this efficient expansion. The expanse of this typical system has increased, to gather the gas needed to supply the increased markets. A pipe of 30-in. diam of steel having a minimum yield strength of 52,000 psi and operating at about 1000 lb is in common usage, with some 36-in., and larger, diam pipe in service. The electric-arc welding process is still used to join the pipe sections in the field.

The compressor stations, however, have changed radically. The reciprocating gas engine still enjoys wide use, but other forms of prime movers are also common. The reciprocating engine of 1958 is three times the size of its 1948 counterpart, and it doesn't always compress the gas with positive displacement compression cylinders but is sometimes connected to a centrifugal compressor, through a speed increaser. Electric-motor-driven centrifugal compressor stations may appear wherever power rates justify their existence, and the gas turbine, in large packages, has made deep inroads into the compressor-station field. Another new feature of our modern compressor station is remote automatic operation, and although this new feature is still the exception rather than the rule, it is proving its ability and worth, every day, on every type of prime mover in use.

At the time of my earlier paper,[1] the Texas Eastern's electric-motor-driven centrifugal compressor had been in service only a short while, so that both time and experience were required to determine its true usefulness. Now, our confidence in this type compressor has been justified in every way. The original compressors were driven by 1250-hp, 3600-rpm, squirrel-cage induction motors with no means of operational control other than suction-valve throttling. Though the gas seal, the means of keeping high pressure gas from escaping from the compressor case around the rotating shaft, had been a critical design problem, the seals were fully satisfactory

Prediction: The natural-gas-pipeline companies will more than double their out-

Pipeline
A hydraulic bending machine, **top**, cold bending 30-in. pipe for Texas Eastern. Pipe is tailored to the terrain, yet remains circular and smooth. The tractor in the foreground holds the pipe during bending. **Below**, crossing the Houston Ship Channel. The pipe, bent to fit trenches dredged across the bottom, was pulled across the channel.

in service. One of the brighter aspects of adopting this equipment was the low estimated operation and maintenance expense of $7.50 per year per horsepower, which turned out to be correct. The cost of electric power, the largest single item of expense associated with these stations, also fell in line with expectations.

Since 1948, some of the original stations have been altered to accommodate the reconversion of the Little Big-Inch line to products service, and some of these original machines have been retired, but not one of them has ever been retired from service for reasons of mechanical difficulty, inefficiency in operation, or obsolescence. Considering the original stations only, the operation and maintenance expenses, exclusive of electric power, have not changed for ten years. This has been accomplished through an accumulation of experience and through economies in maintenance and operation—because, as you know, labor and material costs have increased during this period. The average cost of electric power for these stations increased only 30 per cent from 1948 to 1958, while new gas for fuel at neighboring gas-engine stations is four times its 1948 cost. Of the 113 original centrifugal compressors, 41 are still in gas service and are expected to continue.

These compressors not only proved their own worth but opened a whole new field in compression power equipment. The centrifugal compressor was accepted for use by other gas-pipeline companies only a few years after these original machines went into operation. In 1952 Texas Eastern began a large scale expansion including a new pipeline system beginning in northern Mississippi and joining our existing system in the Pittsburgh area. Along this line we installed thirteen electric-driven centrifugal compressors in four locations. These compressors were rated at 2500 hp and were driven by 3600-rpm induction motors; design modifications incorporated at that time constituted a major step forward in the evolution of the centrifugal machine. The over-all efficiencies were considerably better than those of the earlier compressors and variable-inlet guide vanes were introduced for operational control. Texas Eastern subsequently installed fourteen of these 2500-hp units.

The next two steps of development of the centrifugal compressor came about almost simultaneously, and both brought broad jumps in speed and size. One of these steps retained the electric motor as a prime mover, but this time the operating speed was 6500 rpm, almost twice that of the original compressors. This was achieved through the use of a speed increasing gear driven by a synchronous motor operating at 900 rpm; this motor is rated at 15,000 hp, twelve times that of some of the original compressor drives. Since this is a constant-speed operation, the variable-inlet guide vanes are used on these compressors. Texas Eastern now has seven of these units in service.

Enter the Gas Turbine

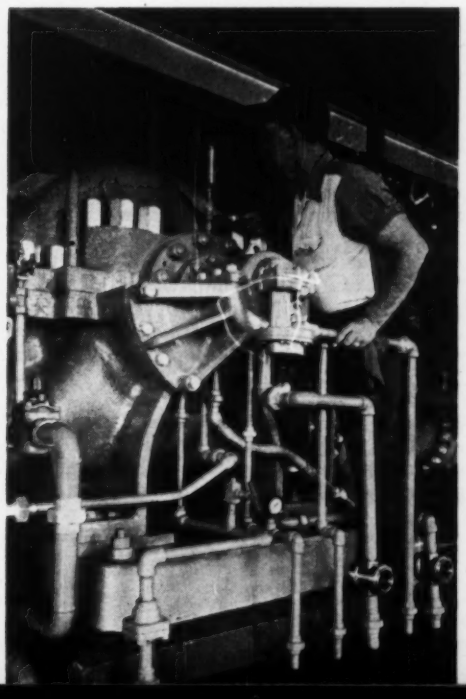
The other step offered nothing really new as far as the centrifugal compressor was concerned but did provide a wider range for its application. This step brought the addition of the gas turbine to the list of prime movers for compressor-station installation. Due to the variable-speed characteristic of the gas turbine, adjustable guide vanes are not employed with that driver.

Up to, and including these developments, only single-stage compression was employed and series installations were necessary when high compression ratios were required. However, the manufacturers immediately came forward with new designs, and in 1958 Texas Eastern installed four, two-stage, centrifugal compressors each driven by a 13,400-hp gas turbine; these are satellite stations, remotely operated from other compressor stations located 25 to 30 miles away.

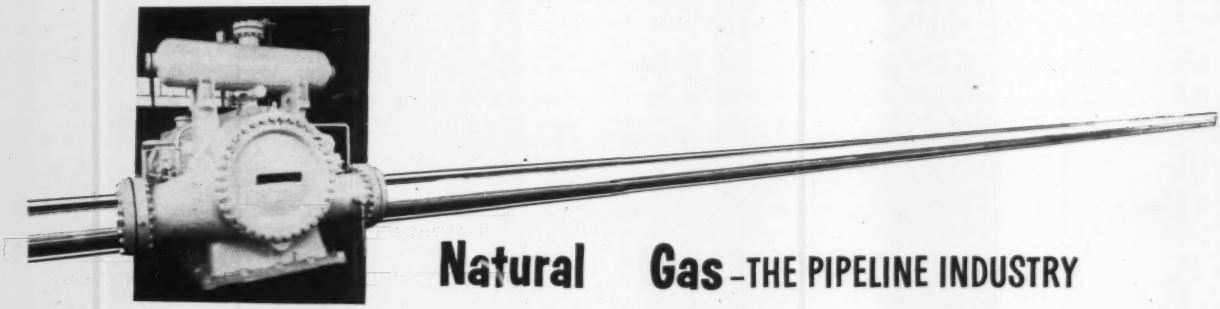
Industry is offering yet another development of the centrifugal compressor, a multistage compression unit in which the impellers can be operated in series, in parallel, or a combination of series and parallel. The centrifugal compressor has come a long way since those

put in 20 years. Already, they supply 26.5 per cent of the total energy market.

First Compressor
One of the first centrifugal compressors in gas-pipeline service, installed by Texas Eastern in 1947. Nineteen of these early compressors are still in service.



The Largest
This 2-stage compressor installed by Texas Eastern near Shermans Dale, Pa., one of the largest in pipeline service, is driven by a 13,400-hp single-shaft gas turbine



original small, single-stage units revolutionized available compression equipment. Texas Eastern alone has nearly half a million horsepower in centrifugal compressors.

A Look to the Future

Now that the natural-gas industry is recognized as an individual entity and not just an offshoot of the Petroleum Industry, and now that it has attained such a prominent position in the economy of our nation, where can it go from here? There are no new market areas to be served; the economic-growth trend of the country is expected to return to nearer its normal rate for a while; there is no critical shortage of fuel and energy; and there is no great backlog of technological developments in the art of pipelining collecting dust on our shelves. But the future is bright and holds fascinating developments.

Since the great pipelines have made natural gas available in every area of the country, new sales will have to be made in the existing market areas through intensive development of overlooked possibilities and through increased service to existing consumers. The prime-type consumer, those that can take deliveries at a fairly constant rate all year around, have been gleaned long ago. This means that further development of a special kind of service will be necessary—the high-demand, low-load-factor type of service. This type of service is already offered in limited quantities, but an ever-increasing demand for additional service falls into this category.

Unfortunately, it is uneconomical for a consumer to store up sufficient quantities of this fuel to meet his peaking demands and even though the natural-gas-pipeline companies are able to provide some of their customers with this service, the underground storage reservoirs are sometimes several hundred miles away.

Then there is an ever-increasing problem of the cost of our commodity on the energy market. In the past, natural gas has enjoyed a price advantage over other types of energy, but the increasing cost of gas in the field and the rising costs of transporting this gas to the consumer are putting it into a highly competitive market; the industry will not always retain the security it has had. But there is still adequate room for expansion of the natural-gas-pipeline industry.

Market Analysis

Just what can the Industry look forward to, say for the next 20 years? The rapid pace at which the natural-gas industry has grown since the end of World War II cannot be expected to continue indefinitely; however, this does not mean a leveling off of the growth rate. Market surveys and analysis show that the demand trend of industry, one of our major consumers, is expected to decline from over seven per cent per year to a little more than four per cent per year, for the next 10 years and then to the more normal rate of two and one half to three per cent per year. This prediction is based on two assumptions—one, that the over-all economy of the country will tend to return to a normal rate of growth; and two, that other types of fuels will present increased competition in the energy market. Market analysts tell us that the commercial and residential-type consumers will offer the best demand trends for the next 20 years. During the next 10 years these consumers should show a seven per cent year growth rate and then slow to a four per cent annual increase. The net result of these predictions means that the natural-gas industry, which is largely the natural-gas-pipeline companies, will more than double its present size in the next 20 years, with two thirds of this growth taking place in the next 10 years. Natural gas will then supply a portion of the total energy requirements of the nation that is greater than the present 26.5 per cent; our portion of the total energy market could easily be above the 30 per cent level, maybe even one third. Estimates of reserves and future production rates indicate that the availability of gas supplies will give no reasons for concern.

But what of our means to accomplish this continued growth? With our commodity entering a competitive state in the energy market and with the ever-rising cost of new gas, the problem of avoiding stagnation rests directly with the gas-pipeline companies, and depends on our ability to preserve the health of this industry by counteracting these forces with more efficient and more economical means of operation and transportation.

The centrifugal compressor and the gas turbine have revolutionized the compressor station and will increase in use and size. Large-sized, single-unit installations of unitized equipment will help keep plant costs down and readily lend themselves to remotely controlled automatic operation. Remotely controlled compressor stations, and groups of compressor stations, are already a reality, and automation of entire pipeline systems is just around the corner. Underground storage fields have done, and will continue to do, an excellent job of keeping the cost of high-peak-load deliveries within reason, but expansion of this type of service may depend on liquefaction and storage of natural gas, and the use of LPG (liquefied petroleum gas) additives. In order to minimize the cost of new plant investment, and its resultant effect on the cost of transporting this gas to market, the industry will need larger pipes, 42 in., 48 in., maybe even 60 in. in diameter and of stronger steel, 70,000 or 100,000 psi yield, perhaps using newer methods of fabrication; or perhaps these pipes will be made of some other material altogether; advancement in this area is desperately needed. And we will need more highly trained personnel to direct and operate these complex systems of the future.

The future outlook for the natural-gas-pipeline industry holds many challenging problems and many fascinating rewards. But the future belongs to those who prepare for it. We are preparing.

The plane can fly, and even land, with practically any other subsystem inoperative—but not without FLIGHT CONTROL

SAFETY ASPECTS OF FLIGHT CONTROL

By Richard Hollingsworth[1] and Morris A. Ostgaard,[2] Wright Patterson Air Force Base, Ohio

MANY people think of safety only in terms of reliability—principally the reliability of components—but there is a distinct difference between aircraft safety and the conventional concept of reliability of components and systems. "Reliability" pertains to the probability that given items will perform properly over a period of time, while "safety" pertains to the capability to cope successfully with the random failures which do occur, without loss of the aircraft or crew. With proper system design, adequate safety can be achieved even though relatively unreliable components are used.

Of course, if more reliable components, or those in which only failures with specific characteristics develop, fewer serious failures will occur and the safety provisions may be less extensive and sophisticated.

On the other hand, if extreme provisions are made for safety, the larger numbers of circuits and components will probably reduce operational reliability greatly.

Although safety must be considered more important than reliability, because of crew considerations and aircraft conservation, if operational reliability is not high enough to achieve acceptable mission success, it is useless to even build the aircraft. Furthermore, performance is intimately connected with safety. If performance is grossly unsatisfactory, safe flight cannot be assured. The trade-off between safety, reliability, performance, weight, cost, maintenance, and other factors, for a military aircraft, must be made on the basis of detailed analysis of the weapon system and its mission and the state-of-the-art in design of various subsystems.

Safety of Flight

It is important that "safety of flight" be clearly dissociated from "mission effectiveness," "completion of mission," "pilot comfort," "pilot skill," and other nonrelated items such as aircraft weight and performance. "Safety of flight" items are those in which a malfunction will almost certainly result in loss of aircraft and/or pilot and encompass only a few select areas such as structural breakup, fire, crew, oxygen, and flight control. As long as the pilot is mentally and physically alert and the aircraft is controllable, he can cope with most other types of malfunctions, possibly make flame-out or emergency landings, or at least control the aircraft until a safe and orderly ejection can be made. Without control, obviously none of this can be done.

Safety requirements are difficult to express in numbers, or even in any other fashion. In the primary-control systems, the over-all reliability which has been achieved in operational aircraft is so high as to almost defy accurate assessment of the failure rate. A lesser over-all reliability cannot be tolerated since, while it is possible to fly and even land the aircraft with practically any other major subsystem in the aircraft inoperative, this cannot be done without adequate control.

Fail-safety is also an important aspect. When a failure occurs in areas where failure to operate is not detrimental, it should not contribute to undesired or uncontrolled maneuvers. Hence hardover automatic-flight-control-systems, AFCS, and wing-flap systems are usually designed to prevent unsafe conditions as a result of the failures. In other words, flight-control failures must not result in situations which seriously threaten the safety of the airplane, regardless of the circumstances.

There appear to be three major areas of safety consideration: (*a*) The performance capability of the over-all systems in terms of aircraft performance, growth potential, and pilot-acceptance factors; (*b*) the basic design and demonstrated capability of the subsystems, including the provisions which have been made to insure adequate performance, reliability, fail-safety, and operation following other failures in the aircraft; (*c*) the design and demonstrated capability of the various components within the subsystem.

System Performance

The fallacious belief, held by many companies, that a manually operated system is safer or more reliable than a fully powered system has placed severe restrictions on systems designers. Changes and additions have been made to cope with growth in aircraft size and performance which have made manual systems bewilderingly complex that were simple enough to begin with. At times, this has obviously resulted in a compromise of the controllability and safety of the aircraft due to both system unreliability and inadequate aerodynamic con-

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trol power. The use of control tabs and balance and antibalance tabs and large mazes of linkages and springs have been among the attempts at modification of manual control to make it adequate. However, these modifications to portions of the manual-control systems have, on occasion, been inadequate and have forced redesign of a completely powered system.

Pilot acceptance of control-system operation and aircraft-handling qualities is quite important to safety. Control-force levels must be low so that the pilot can easily operate them. They must be exceptionally smooth and consistent. Adequate warning of stall, pitch-up, and approach of limit-load factor must be given. Available control rates must be high enough to prevent saturation of the system. The stick force per *g* must be relatively constant throughout the flight regime. When these criteria are met, the pilot can control the aircraft through experience, intuition, and feel and will be able to achieve the desired flight path with a minimum of attention to the control system. When unexpected variations occur in control-system response, pilots are apt to take drastic action and abandon the aircraft.

System Design

Proper design of the basic primary flight-control system cannot be overemphasized since the features of the system provide safety by reducing or eliminating the adverse effects of component failures within the system and compensate for changes in the basic aircraft performance or capability. In addition to the normal considerations of performance, weight, and function, the effects of failures at any point in the system throughout the flight envelope, aircraft growth, change in mission, and other factors must be weighed in order to arrive at an acceptable and safe design.

First, is the control-signal path from the pilot to the primary control surface or device. There are no preconceived ideas of the exact nature of this part of the system. However, safety requirements have, to date, dictated the type of system. The present requirement for the equivalent safety of a dual mechanical system has resulted in continued use of the mechanical systems, since no suitable substitute is available. However, there has been talk of "fly-by-wire," or electrical control, and it is obvious that there are many advantages to such a scheme. It will be lighter, more easily routed, have good response, can be easily shaped or operated upon to provide desired sensitivity, *g*-limiting, and so forth, and can readily receive inputs from the various guidance systems. Past reluctance to rely wholly on such a system, however, arises from the lack of demonstration of acceptable long-term operation and safety, regardless of random failures, extraneous inputs, and environmental conditions. The usual approach to the problem of adequate electrical systems has been redundancy, monitoring, switching, and other devices which usually add more problems than they solve owing to the large increase in number of components. Eventually, fly-by-wire will be utilized extensively when developed into a simple yet safe system.

Why the mechanical type of system should be duplicated is a long-standing question. "It is obvious that mechanical components, that is, cables, bolts, bearings, and the like, are reliable." Reliability, in terms of mean time between failures, is difficult to determine since the structural failure rate of the devices themselves is quite low. However, failure of the mechanics to install the components properly is quite frequent.

The most important reason for duplication is to prevent loss of the aircraft following maintenance errors and occasional random failures. The impracticability of total dualization is realized as well as the need for proper system design to protect, if possible, against failures in the unduplicated or otherwise unprotected areas. Proper location and design of feel devices, trim devices, centering springs, and so forth, can often prevent uncontrolled maneuvering following a system-linkage failure and in some cases even permit a safe landing to be made. In any case, the unduplicated areas should be the subject of special design considerations to insure maximum safety. When dual systems are installed, it is wise to take advantage of this fact and provide additional protection from localized fires, structural failures, and combat damage by separating the systems as widely as possible.

Supporting Power Systems

Probably the most difficult and controversial portions of the primary-control systems to design are the supporting power systems for fully powered controls; that is, the hydraulic, pneumatic, or electrical systems. Duplication of these systems, and of the actuating devices, is necessary in order to protect against a single-system failure. However, the specific design and the manner in which they are integrated into the remainder of the aircraft subsystems can vary greatly. Increasing interdependency of the various subsystems upon each other, greatly expanding power requirements, the more critical nature which many of the subsystems are assuming, and the weight penalties which can accrue make it difficult to keep a proper perspective on the safety aspects.

Initially all subsystems should be carefully reviewed and categorized according to the effect on flight safety. Those critical to safety of flight should be provided with appropriate separate power sources. At least one of these power sources must be restricted to supplying only the most critical items. Such uncritical functions as rudder control on single-engine aircraft, automatic flight-control servos, wing flaps, and so on, would not be included.

The problem of supplying power to the flight controls following engine failure has caused extensive controversy. Many believe that dead-stick landings cannot, or at least should not, be made and this is true for large bomber and cargo-type aircraft. However, dead-stick landings have been achieved in every fighter, trainer, or single-engine operational aircraft. Further, there are occasions when bail out is impractical or undesirable and dead-stick landings are required, such as following flameouts on final approach, crew injuries, escape-system failure, or flameouts over heavily populated areas. When experienced pilots are at the controls and conditions are favorable, there is usually no reason why a dead-stick landing should not be made in these types of aircraft. Statistics for 1958 and 1959 show that out of 698 dead-stick landings by Air Force jet pilots, 600 were successfully accomplished and less than 100 resulted in damage to or destruction of the aircraft. The augmentation of hydraulic flow rates for the greater and faster con-

trol motions required as airspeed falls off has been accomplished through use of electrically driven pumps, ram-air turbines, flow-sensitive pressure regulators, and other devices, all of which have been satisfactory when applied properly.

Longitudinal trim, which is normally considered to be secondary control, has caused an unusual amount of difficulty, primarily because of the fact that some of the trimmable stabilizers in use have a greater aerodynamic authority than the corresponding elevator control. Failure of such systems cannot be overpowered by the primary controls. When efforts are made to keep this type of system safe by duplication and safety devices, it becomes so complex that it may actually be less safe and may often become inoperative when most needed. These systems must be designed as primary-control systems, from the standpoint of safety and reliability. The authors have no suggestions as to how such a system can be made safe except to either limit the aerodynamic authority to a value which can be overpowered by the primary (elevator) system or, preferably, combine the elevator and stabilizer systems into a single power-operated system, utilizing artificial-feel trim, and with a one-piece horizontal tail.

Automatic flight-control systems, including stability-augmentation systems, vary greatly in required functions and reliability; thus the means of achieving safety may be quite different from one aircraft to another. The basic requirement to be met, based on past experience, is that no single failure, or no undetected failure plus one additional failure, can cause a malfunction of a nature which could result in excessive maneuvering or the attainment of limit load factor. Some of the means used to accomplish this include, servo torque limiting, automatic trim to reduce engage and disengage transients, command signal limiting to prevent guidance systems from inserting dangerously large signals, deactivation of manual trim, interlocks to prevent switching to incompatible modes, limits on control authority to reduce the effects of hardover failures, multiple means of disengagment, and disengage warning devices.

Design of an AFCS to provide continuous high-performance operation to insure safety during a certain phase of flight, such as stability augmentation in an unstable flight regime, requires advanced concepts and methods if an efficient, reliable, and safe design is to be achieved. The greatest emphasis by industry to date has been directed toward improvement of existing components to reduce failure rates and toward the design of multiple redundant circuits so that, when one fails, others can perform the function. Neither of these approaches is wholly satisfactory since the first one is costly and still provides no real protection against random failures and the second one increases the complexity of the system and accordingly the number of points where failures can occur.

There are, however, new design approaches in components and circuitry which will allow component failures to occur in the system with only slight reduction in system performance. Thus, as previously noted, there can be relatively safe systems which are composed primarily of unreliable components and these systems need not be excessively complex or redundant. A significant advance in this concept would make a great contribution to the safety of future aircraft which will rely increasingly on automatic-control functions.

The ultimate demonstration of system performance and safety occurs, of course, during actual flight and much attention must be given to proper flight testing for this purpose. However, prior to any flight testing, there must be enough simulator test time to insure basic performance and verify the safety features. For this purpose, an accurate mock-up of the control systems and supporting subsystems, a simulation of the aircraft dynamics, and suitable instrumentation, cockpit representation, and so on, are required. In addition to normal "flying" throughout the flight regime, tests should include all conceivable unusual conditions, partial or complete component failures, extraneous inputs, failures of supporting subsystems, and failure of other major systems such as engines, to determine the capability of the pilot to retain control of the aircraft. Inability to maintain control may be indicative of a need for system redesign in some areas before actual flight of the vehicle occurs. Conditions of marginal control define areas in which actual flight testing should be used to establish control performance and safety. Such programs as this will enhance the probability of successful and safe weapon-system development and operational usage.

Component Design

The term "components" refers to all of the various parts of the system, from the connecting nuts and bolts to complex subassemblies such as actuators or amplifiers. Integrity of the components must be high, even in a system which can accept failures, so as to keep performance high, maintenance low, and reduce the possibility of multiple component failures causing a system failure. Items to be considered include structural strength, simplicity, maintainability, and resistance to adverse environments. Typical of requirements are:

1 Bolts of less than $^1/_4$-in. diam shall not be used in single bolt attachments, due to possibility of damage due to overtorquing.

2 Spring pins shall not be used unless positively retained by means other than their own spring action, as improper installation can frequently occur.

3 Self-locking nuts shall not be used on bolts in critical single-bolt joints unless other provisions are also made for bolt retention. This protects against poor installation practices and substandard nuts.

4 Chain shall not be used, unless specifically approved for each individual application, because of the many small components and joints.

5 Retaining rings may be used only where their loss will not result in failure of the assembly. Failure to properly seat the rings frequently occurs in service.

6 Push-pull rods shall have only one adjustable end fitting, to prevent changes of rod length in the event of loose-rod end-locking means.

7 Hydraulic servo valves shall be spring-loaded to the neutral, or most safe, condition to prevent maximum rate hardover operation in the event of a linkage failure.

8 When bolts are installed vertically, the heads should be up so that the bolt will not fall out if the nut is not installed.

9 Guides or rollers should be installed around push-pull tubes to prevent their falling into structure in the event that one end comes loose.

Requirements such as these cannot be applied arbitrarily across the board because of physical design limitations but do provide a sound base of design practices to enhance the integrity and safety of any system.

CONDENSING WATER

- How does it affect the river?

By Melvin D. Engle,
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Chief Mechanical Engineer,
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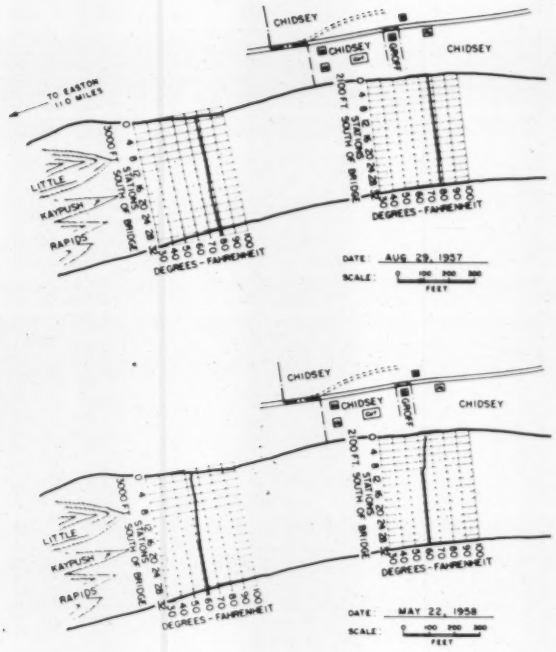
and Light Company,
Allentown, Pa.

Power plants are good neighbors. An element in the handling of our water resources is the discharge of condensing water into the rivers. This study showed no harmful effects to fish or plant life.



TEMPERATURE SURVEY
DELAWARE RIVER
MARTINS CREEK STEAM ELECTRIC STATION

Fig. 1 Surface-water temperature traverses of the Delaware River were made in the vicinity of the Martins Creek plant. These

THERE has been considerable discussion of the aquatic effects resulting from the discharge of the condensing water from power plants and cooling water from industrial plants to rivers and lakes. Little substantiated information is to be found, and that which is available is insufficient to permit reliable conclusions.

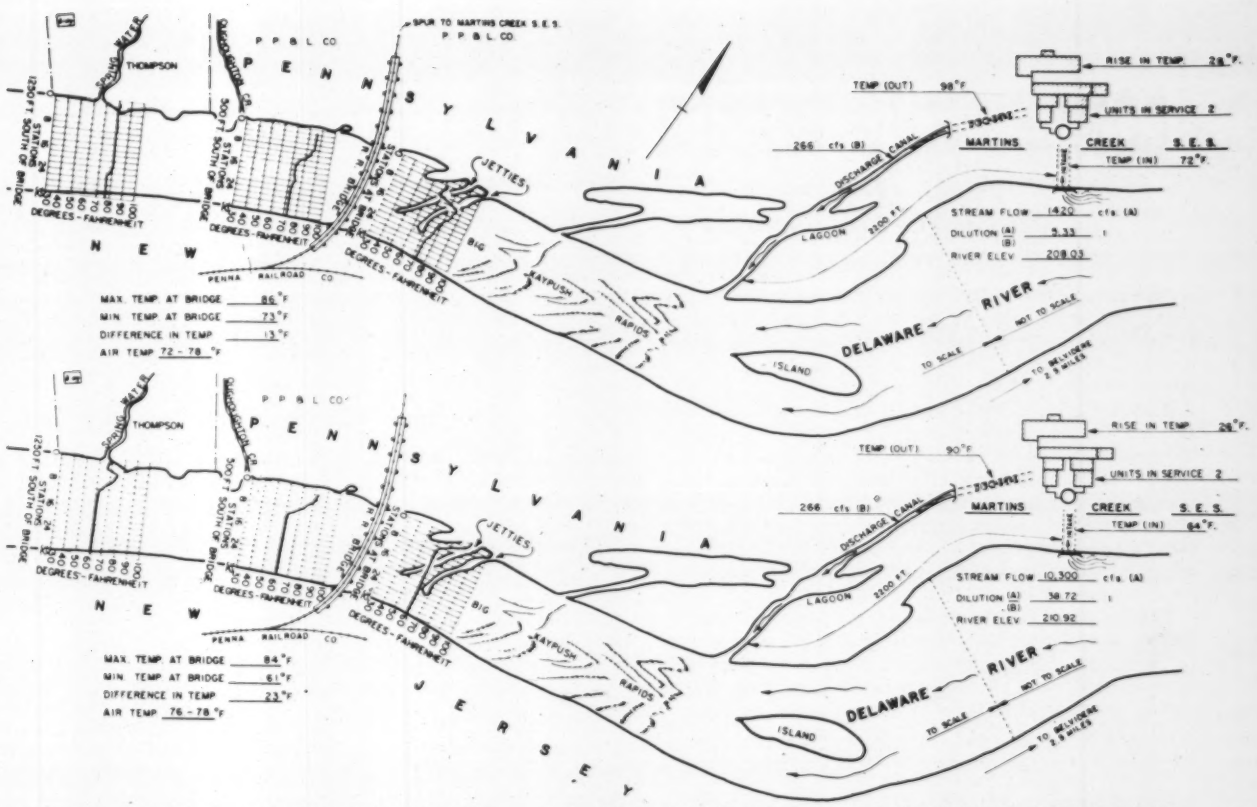
Rivers and lakes are natural resources which are used for many purposes. They are of great interest to all and they should be used for the maximum benefit of all. With proper management, the flood-control, water-supply, recreation, and transportation uses as well as waste-disposal, cooling, and power-generation can all be served. To exercise this proper management it is necessary to know how use for one of these purposes affects the others.

Since 1956, the Lehigh University Institute of Research under the direction of F. J. Trembley, Professor of Ecology, has been conducting research in the Delaware River near Martins Creek, Pa., on the effects on aquatic life resulting from the discharge of the condensing water from the Martins Creek Steam Electric Station of the Pennsylvania Power & Light Company.[1]

This location is ideally suited for the purpose because

[1] A Water Quality Station of the United States Public Health Service is also located at this steam-electric generation station.

Contributed by the Power Division and presented at the Winter Annual Meeting, New York, N. Y., November 27–December 2, 1960, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Paper No. 60—WA-92.



were first measured from the railroad bridge crossing the river 1500 ft below the entry of the condensing-water discharge canal. The use of convenient measuring points there resulted in a total of 32 separate stations and this number was adopted as standard for the other traverses regardless of the width of the river at the points where these were made.

the Delaware River at Martins Creek is a clean stream. Very few industrial plants are located upstream and any effects of the discharge of the condensing water are quickly apparent without being clouded by other factors.

In order to study the temperature distribution of the condensing water returned to the river, a number of temperature-measuring stations were established on the railroad bridge crossing the river 1500 ft below the point where the discharge canal enters the river and 500, 1250, 2100, and 3000 ft downstream from the bridge. Many surface-water temperature traverses have been made, under various river conditions, from these stations. Temperature-depth profiles have also been obtained to study the distribution of the warm water from the surface to the bottom of the river. The various features of the site and the traverse points are shown in Fig. 1.

Temperature Effect on the River

Two series of charts have been selected from the many traverses of surface-water temperature. The chart, for August 29, 1957, shows how, for a low flow in the river, 1420 cfs, the rapids in the river and the stone jetties mixed the water from the discharge canal with the water in the river so well that, at the station 2100 ft downstream from the railroad bridge, the temperature of the surface water was practically the same from shore to shore.

For the higher flow condition—10,300 cfs—on May 22, 1958, the rapids in the river and the stone jetties were not as effective in mixing the discharge water from the station with the water flowing in the river. As a result, the condensing water hugged the Pennsylvania shore more closely. However, Fig. 1 shows that the greater dilution of the greater flow in the river returned the temperature of the surface water along the Pennsylvania shore to within 4 F of the intake water temperature, 2100 ft downstream from the railroad bridge and to within 1 F, 3000 ft downstream. The temperature of the surface water along the New Jersey shore was not affected by the discharge of the condensing water to the river.

The principal fact indicated by these two charts is that, for the Martins Creek location and conditions, the surface-water temperatures had pretty well returned to normal 4500 ft downstream from the point where the discharge canal enters the river. However, the configuration of the river, jetties, and rapids and the relative flow in the river will vary the mixing of the condensing water with the river water for almost every location.

Surface-water temperatures, however, are not the whole story. A temperature-depth profile of the river, 3100 ft below the point where the discharge canal enters the river and for a flow of 1630 cfs, is shown in Fig. 2. It can be seen that the water discharged from the station lies on the surface of the river and does not affect the river water more than 2 ft 6 in. below the surface. For this particular condition, 85 per cent of the water in the river at this point was not affected by the water discharged from the station.

Furthermore, the aquatic life at this point is practically

CONDENSING WATER

- How does it affect the river?

unaffected by the water discharged to the river except along one shore line. Also, the change in temperature at the shore line is too small to be of any significance even in the warm part of the summer when the normal river temperature was 80 F.

Another general conclusion is that the area of the river affected by the discharge of the condensing water is a triangular area with its apex at the point where the discharge canal enters the river and widening out downstream as the condensing water spreads across the surface of the river. In practically all of this area the temperature of the river water at the bottom of the river is unaffected by the discharge of the condensing water to the river.

The length of the triangular area in the river, where the surface water temperature will be affected, depends upon: (*a*) The flow in the river as compared to the flow of condensing water to the river; (*b*) the mixing effects of rapids, configuration of the river bottom, jetties, and similar factors; (*c*) the width of the river; (*d*) the velocity of the river; (*e*) the normal temperature of the water in the river and the temperature of the condensing water entering the river. It will vary from day to day because of the number of variables and will vary widely for different locations.

In no case at Martins Creek has any serious temperature effect been found to result from the discharge of the condensing water to the river. As soon as the condensing water enters the river, it spreads out on the surface and gives up its heat to the water below and to the air.

Botanical Life In the River

The plant life of rivers is highly important for several reasons.

Although the rooted aquatic plants and algae growing in the rivers consume oxygen during the hours of darkness, they give off a large amount of oxygen during the daylight hours and the net effect is to add considerably to the oxygen content of the water over a 24-hr period. The oxygen in the river water enables the river to purify itself of the pollutants that may be present either naturally or discharged to it from cities and towns.

A few aquatic plants absorb oxygen from the river water during the day as well as the night, but the only ones found in the Delaware River at Martins Creek that do are the blue-green algae, and this type of vegetation is present in a very small amount.

Plant life is also the base of the food-production line for all aquatic organisms. They are eaten by small crustaceans, snails, and some species of fish. Smaller fish are in turn eaten by larger fish and the food chain is thus established for all of the aquatic animal life.

An example of the botanical surveys made upstream and downstream in the Delaware River is the one of August 13 and 20, 1959, shown in Fig. 3. The same rooted aquatic plants and algae were found growing with the same vigor upstream and downstream from the point where the discharge canal enters the river, except along the Pennsylvania shore just below the discharge. Here, for a distance of about 1500 ft, only green algae and blue-green algae were found and the growth was not as great as upstream from the discharge and downstream below the railroad bridge.

An interesting point noted in the surveys was that while in 1957 and 1958 few green algae were found in this area, in 1959 a considerable growth of green algae existed. Apparently the green algae, which were pretty well washed out of the river by Flood Diane in 1955, were somewhat slower in re-establishing themselves in the warm-water area than in other locations, or else a more warm-water-tolerant strain was becoming established in this part of the river. Only the future will supply the answer. The blue-green algae in the area below the discharge canal were minor in amount.

All in all, it can be stated that the aquatic vegetation of the river was not materially changed by the discharge of condensing water.

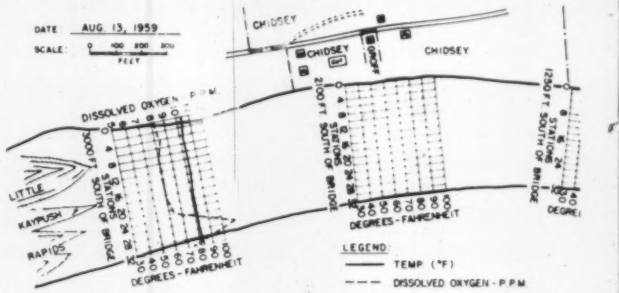
Chemistry of the River Water

The chemical property most likely to be affected by the discharge of condensing water is the oxygen content. It is unlikely that the other chemical properties such as alkalinity, organic load, or silt load will be affected by the addition of a moderate amount of heated water.

In addition to the effect of aquatic vegetation, the oxygen content of river water is dependent upon many variables such as: (*a*) The area of the surface of the river exposed for the absorption of oxygen from the air as compared with the flow of water in the river; (*b*) the rapids, jetties, dams, or other obstructions in the river causing turbulence; (*c*) the organic load discharged to the river from the watershed or by cities and towns.

Water has a natural affinity for air depending in degree upon the temperature of the water with the greatest amount absorbed in winter. Large quantities are absorbed at the surface directly from the air in contact with the surface and air is absorbed at an even higher rate when the water is agitated by rapids, jetties, or falls.

In passing through a condenser in a power plant, the water is heated, resulting in a slight loss of oxygen if the intake water is at or near saturation and an even lesser amount or none if the intake water is below saturation.



DISSOLVED OXYGEN SURVEY
DELAWARE RIVER
MARTINS CREEK STEAM ELECTRIC STATION

Fig. 4 The dissolved-oxygen survey showed a slight decrease in the amount of dissolved oxygen when measured 500 ft below the rail-

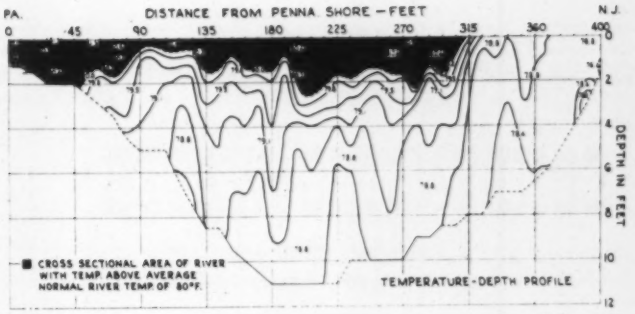


Fig. 2 Temperature-depth profile of the Delaware River 2100 ft below the point where the condensing-water discharge canal from the Martins Creek plant enters. The dark shading represents the cross-sectional area of the river where the temperature exceeded the average normal of 80 F. The contours represent water temperature in deg F.

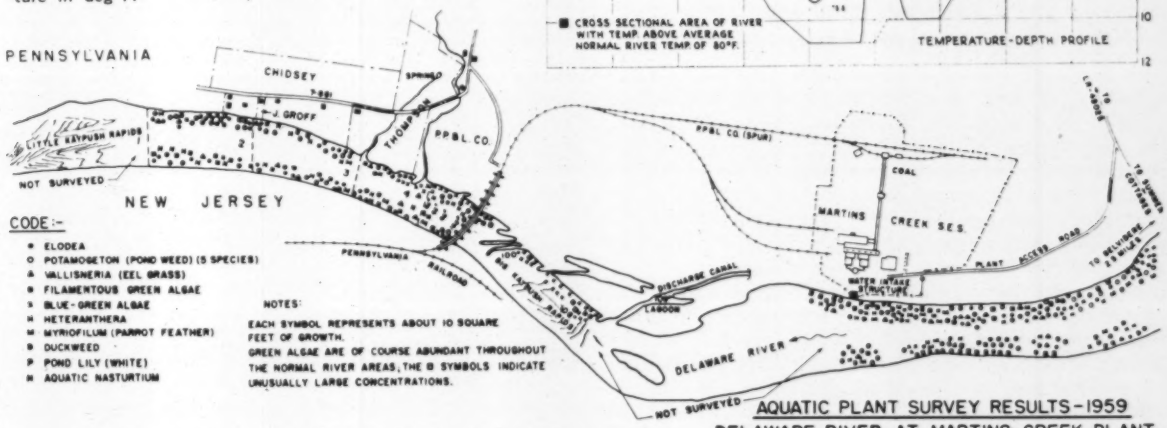


Fig. 3 Aquatic-plant survey of the Delaware River in the vicinity of the Martins Creek Plant. The same rooted aquatic plants were found growing with the same vigor upstream and downstream except along the Pennsylvania shore just below the point where the discharge canal enters the river. Here, for a distance of about 1500 ft, only green algae and blue-green algae were found and the growth was not as great as at other points.

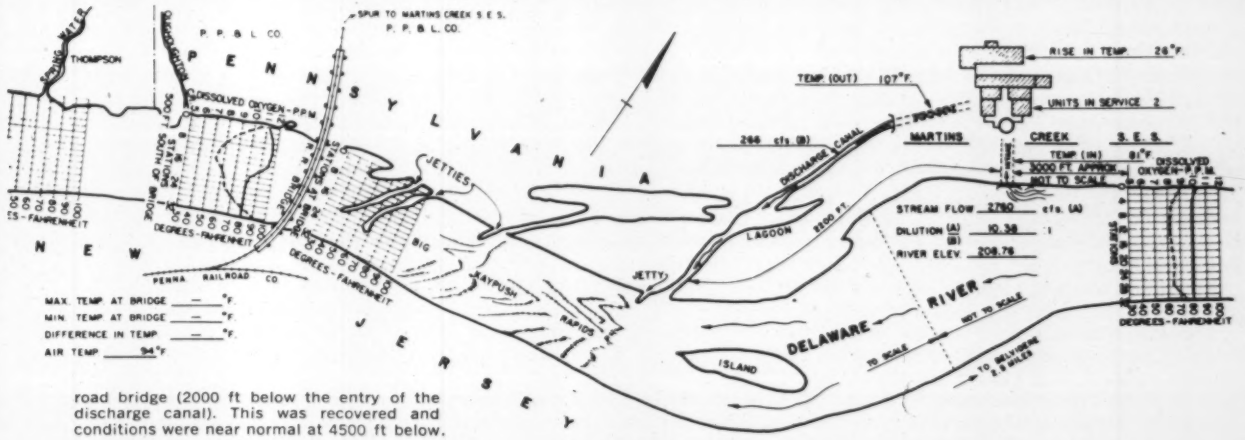
However, none of the tests—an example is shown in Fig. 4—at Martins Creek have shown that the reduction in oxygen content is serious and they have shown that the recovery of oxygen is quite rapid as soon as the water has been returned to the river.

It is interesting to note the effect of the rooted aquatic plants and algae growing in the river near the two shores. They were giving off oxygen at such a high rate on the day that the traverse shown in Fig. 4 was made that the water in the whole river was saturated and the water near the shores was supersaturated. The heavy growth along the New Jersey shore 3000 ft downstream from the railroad bridge contributed an extremely high degree of supersaturation.

Fish and Fishing

During the research work at Martins Creek, 37 species of fish have been taken from the river and undoubtedly many others have not been identified. In size they vary all the way from small food fish to 15-lb 34-in. monsters. In other words, the fishing is excellent.

It has been pretty well proved that the best fishing in the river, except for the hottest months of the summer, is a short distance downstream from where the discharge canal enters the river. In fact, this is the only good fishing location in the river during the early spring and late fall and winter, when the fish are dormant in other parts of the river. Fishing is actually improved considerably and the season is lengthened by the discharge.



road bridge (2000 ft below the entry of the discharge canal). This was recovered and conditions were near normal at 4500 ft below.

CONDENSING WATER

- How does it affect the river?

Fishing surveys have been made in the warm-water areas of the river and in the normal river-water areas in the early spring and late fall and it has been found that the fish congregate in the warm-water areas at those times when they would otherwise lie dormant in the normal cold water of the river. Fish seek out those areas where the water temperature is most to their liking, and avoid places where the temperature is too high.

During the cold weather, many fish swim into the discharge canal and remain there for long periods because of their preference for the warmer water. On one occasion in late November, 1958, Dr. Trembley and his assistant caught 100 bass in 1 hr in the lagoon which connects with the discharge canal. This was at a time of the year when fishing was not too good in the cold water of the river.

In December another fisherman caught 72 bass in 3 hr while fishing in the river below the point where the discharge canal enters the river. During the winter of 1959–1960 excellent catches of walleyed pike were made. It was a strange experience to find good fishing in a river with the temperatures at 32 F or below. Needless to say, the fishermen loved it.

During the warmest months of the summer, there is a triangular-shaped area in the river from which the fish will move out to areas where the water may be at a temperature more to their liking. This triangular-shaped area starts at the point where the discharge canal enters the river and widens out as the water flows down river. The length of the area from which the fish will migrate during the hottest months of the summer depends upon many factors and will vary from day to day.

Likewise, the fish will migrate into this same area from the colder-water areas of the river, during the greater part of the year when they prefer the warmer water temperatures. They actually enter the discharge canal and stay there for long periods of time.

A number of tests have been made, and are continuing, of the heat tolerance of the fish found in the river. The LD-50 temperature for the various species has also been tested. (LD-50 temperature = the water temperature at which 50 per cent of the fish will survive.) The flume constructed on the property for this purpose is 42 in. wide by 76 ft long and is provided with water-heating facilities. The temperature of the flowing water in the flume can be regulated from river-water temperature at the inlet end to approximately 45 F warmer at the outlet.

The principal facts learned so far are that the LD-50 temperatures published in the literature seem to be too low. This may be because the tests are based on too short a period. The possibility that they failed to survive because of heat shock and their true LD-50 temperature would have been obtained with a longer acclimation time is suggested by their behavior during the late fall. A large number of fish of many species leave the cold river at that time by entering the discharge canal. They swim up to a lagoon halfway between the place where condensing water enters the canal and the place where it enters the river. Here they become trapped as the temperature in the water of the discharge canal rises in the spring and they remain all summer. During the heat of the summer the water in this lagoon reaches temperatures considerably above the reported LD-50 temperatures for these fish. In spite of this, they survive, are active, strike at lures, and provide good fishing.

The possibility that the discharge of the condensing water to the river may result in fish kills has been investigated. Since fish kills take place to about the same extent both upstream and downstream from the station, they seem to be due to other causes. Fish kills take place in all rivers, streams, and lakes every year, for many reasons. There has been no indication that the condensing-water discharge was responsible. The fish are smart enough to move out of those areas of the river where the temperature of the water is not to their liking.

Conclusions

The Delaware River at Martins Creek, Pa., is an ideal location for research on the aquatic effects resulting from the discharge of the condensing water from a power plant to a river. The following general conclusions can be drawn from the research done at this location:

1 The condensing water entering a river from the discharge canal of a power station usually spreads out on the surface of the river unless rapids, dams, eddies, or other obstructions in the river cause it to mix with the river water. The temperature of the water at the bottom of the river is usually not affected.

2 The distance downstream from the power station, where the surface river water returns to normal, will vary with almost every location and depends upon so many variables that no general statement can be made.

3 The botanical growth in the river is not affected, except for a small triangular area starting at the point where the discharge canal enters the river.

4 The chemistry of the river water is not affected, except for a small reduction in oxygen content in a small triangular area starting at the point where the discharge canal enters the river. The loss in oxygen content is never serious enough to adversely affect the aquatic life.

5 Fish have the ability to stay out of areas in the river where the temperature of the water is not to their liking.

6 There are no fish kills in the river resulting from the discharge of the condensing water to the river.

7 In the late fall, winter, and early spring the fish congregate in the warm-water areas of the river caused by the discharge of the condensing water to the river.

8 Fishing is best in the river a short distance downstream from the place where the condensing water enters the river, except for the hot summer months. In fact, in the winter, early spring, and late fall this is the only location in the river where there is any good fishing.

9 The good fishing season in the river is prolonged as a result of the discharge of the condensing water.

10 Over-all fishing in a river is improved as a result of the discharge of condensing water to the river.

11 Local conditions govern the aquatic effects resulting from the discharge of the condensing water from a power plant to a river. Until more complete information is obtained, each case should receive individual study and treatment.

How SAFE is your INDUSTRIAL VENTILATION

It must be safe for its own operating and maintenance personnel—and also for the plant. Ford engineers have established safety standards.

By E. M. Schmidt, Chief Mechanical Engineer, Engineering and Construction Department, Plant Engineering—Manufacturing Staff, Ford Motor Company, Dearborn, Mich.

INDUSTRIAL ventilation for the purpose of this paper may be either dilution ventilation or comfort ventilation. Dilution ventilation, as the name implies, refers to the dilution of contaminated air with uncontaminated air in a general area, room, or building for health hazard or nuisance control. The purpose of comfort ventilation, on the other hand, is not to keep personnel comfortable in the ordinary sense but to actually prevent acute discomfort or physiologic damage from abnormal atmospheres. Since the equipment used for either application is practically identical, no distinction will be made as to its use. Process exhaust usually directly connected to its cause is a highly specialized field and will not be discussed other than in occasional references.

The safety aspect of industrial-ventilation equipment is many-pronged. It has to be safe as far as the operating and maintaining personnel is concerned. It has to be safe for the employees for whose benefit the system was installed. It has to be safe for the process that may have caused its installation. It has to be safe from self-destruction.

Exhaust systems, air make-up systems, and industrial-heating systems will be considered and covered separately as to their purpose, function, and the safety considerations in their design, installation, and operation.

Exhaust Systems

The exhaust of air out of an industrial facility constitutes the base, the starting point, upon which industrial ventilation is built.

Every industrial automotive plant has some inherent process in its operation that requires exhaust to discharge air to the outside of the building usually after some cleansing operation. The air that is blown out of the building came from the immediate area around the process installation. The replacement air may come from open windows and doors in the summertime, from some other part of the building, or by robbing some other less powerful, exhaust system of its share of air. If it comes from some other part of the building it may bring along contaminants and drag them past personnel and other processes on the way. Winter compensation for closed windows and doors, seasonal and part-time operations, and temporary processes which may be eliminated must all be considered.

At the author's company after considering air changes, breathing zones, air-movement zones, and dead-air zones, a fairly simple design criterion was established for ventilating industrial facilities. It is based on exhaust and requires: (*a*) 2 cfm per gross ft of floor area during the ventilating season for medium-discomfort type of plants such as assembly, light fabricating, and warehousing; (*b*) 3 cfm per gross sq ft for heavy-discomfort type of plants such as engine plants, transmission plants, stamping plants, heavy fabricating, general areas of foundries and glass plants, and paint and bake areas. Special areas in foundries, glass plants, die-casting and heat-treat areas get special treatment, of course.

During the heating season, this exhaust is reduced to $^1/_2$ and 1 cfm per gross sq ft, respectively, or to the amount of the process exhaust, whichever is greater. The total cubic footage of air to be exhausted is reduced by the amount of permanent, year-around process exhaust and by a credit for open windows equal to the area of the bay adjacent to the perimeter walls with windows, times the number of cfm per sq ft.

The balance is exhausted by comparatively cheap roof-mounted propeller exhaust fans, Fig. 1, of 20,000-cfm capacity each on a 2-cfm-per-sq-ft design and 30,000 cfm capacity each on a 3-cfm-per-sq ft design. These are of simple construction—an electric motor, a propeller, and a sheet-metal housing with gravity dampers to keep the rain out when the fan is not operating. A three-page company "Standard" on this piece of air-handling equipment establishes a quality base and the safety aspects. The standard will be considered in detail in the section on equipment.

The safety requirements and other additional quality-control features do not run the cost up on these units. Although they are known as the Ford Standard roof exhausters in the ventilation industry, the cost is less today than it was several years ago for a lot less desirable piece of equipment.

Contributed by the Safety Division and presented at the Winter Annual Meeting, New York, N. Y., November 27–December 2, 1960, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Paper No. 60—WA-190.

How SAFE is your

INDUSTRIAL VENTILATION

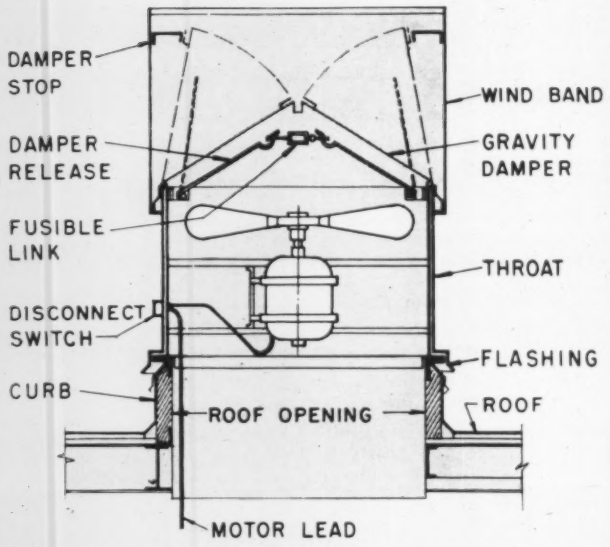


Fig. 1 The Ford Standard roof exhauster is the basic unit in the exhausting of air that could cause physiologic damage. It is safe in operation, safe for the process which required it, and safe for personnel both in the affected area and those charged with maintenance.

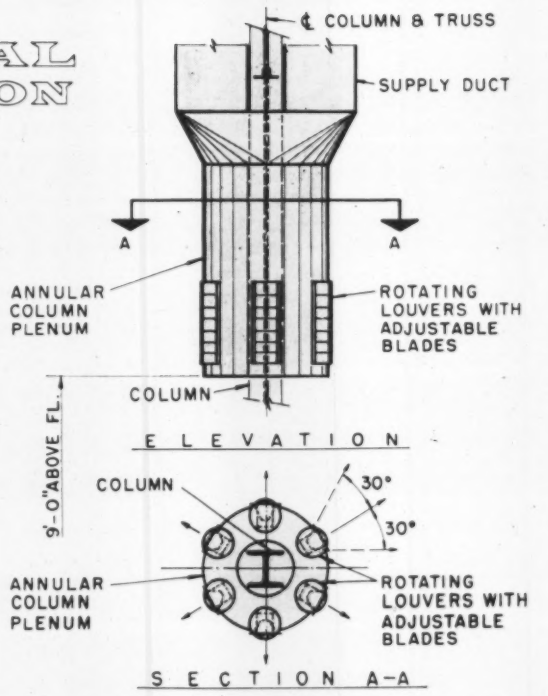


Fig. 2 Annular-ring column diffusers replenish the air removed by the exhaust systems, supplying it at the 10-ft level where it has the most benefit for the employees. Drum louvers allow extreme flexibility in the direction of the disbursement of air.

The other exhaust systems used for industrial ventilation, such as duct work with vane-axial or centrifugal exhaust fans, are identical to the equipment used for air supply and will be covered there.

Air-Make-Up Systems

Air-make-up systems, as the name implies, replenish the air removed by exhaust systems, process, or ventilation. Air make-up in its simplest form may be opening a window to allow drawing of air to an area with a negative pressure condition. In its most extensive form, air make-up may be a system consisting of air-intake louvers, automatic dampers, filters, a controlled air-heating medium, fan, duct work, and diffusers. The point of application of make-up air is of prime importance. The most successful installations have been the ones that supply air directly to or at the point of exhaust. This minimizes drafts and the possibilities of additional contamination and usually results in a saving of equipment capacity. However, a directly applied air-make-up system can only be justified where the exhaust is localized and extensive, or where the area air has been conditioned and is too expensive to throw away, or where it is required by code. Normally, in ventilating an industrial area, good results may be obtained by literally "dumping" make-up air into the building at strategic spots and allowing it to find its way to the negative-pressure areas created by exhaust systems.

When exhaust units are located on the roof and make-up air is supplied above the truss line, it will not benefit the employees. It is either short circuited directly to the exhaust fans or else it is shot down through and mingles with layers of hot, contaminated air before it reaches the occupant zone. At the author's company, the air is introduced at a 10-ft level with a specially designed annular ring column diffuser, Fig. 2. The drum louvers incorporated into the diffuser allow extreme flexibility in the disbursement of the air, up, down, left, right, straight, or any combination of these movements.

The diffuser may be supplied through duct work by a central-fan system, individually packaged fan-coil sets, indirectly fired industrial gas and/or oil heaters, or direct-fired industrial gas heaters.

At this point the difference between an air-make-up system and a heating system becomes slightly vague and both systems will be covered. During the heating season an air-make-up system must temper the air it discharges to at least the maintained temperature of the area it serves, making it relatively simple to provide additional heat to the air to counteract heat loss through walls and roof of the facility. Economics enter into the picture since heating of outside air is expensive. At the author's company, the wall and roof heat losses of the adjacent bay are counteracted by inexpensive, 100 per cent recirculating, vertical-throw perimeter unit heaters. The make-up-air units are then designed to pick up the roof losses only.

A central-fan air-make-up system, consisting of air-intake louvers, automatic dampers, filters, steam coils, centrifugal or vane-axial fan, duct work, and suitable diffusers, is by its very nature a fairly safe installation, particularly if quality products from reputable manu-

facturers are specified.[1] Steam coils must be protected from freezing in order to prevent coil damage and possible injury to personnel and other equipment. Steam-distributing coils, freeze-up controls, and proper venting and trapping can prevent many of these problems. Fans, either vane-axial or centrifugal, can be made safe by specifying operation within accepted outlet velocities. Screens on the inlet side of the fans should be provided when they are operating in or drawing out of a plenum. An overheat device incorporated in the system can be connected to stop the fan and ring an alarm in case of a dangerous temperature increase.

Fan-coil units are actually packaged small-scale central-fan systems of limited air-handling capacity. The basic unit consists of a fan and a coil. Dampers, filters, additional coils, duct work, and diffusers may be added to suit the application. The same precautions apply as in the case of the central-fan system. Adequate coil specifications, fan-speed limitations, and accessibility requirements will insure a unit that is safe.

Quite often, economics dictates the use of indirect oil and/or gas-fired industrial heaters. In principle, these units are similar to the fan-coil units except that the heating medium is a primary and a secondary heat exchanger. Combustion of the fuel and the high temperature of the products of combustion provide heat to the air passing over and around the heat exchanger. There is no intermingling of the products of combustion with the air.[2] Proper controls and proper installation of controls are of prime importance on this unit. The controls must meet the most recent recommendations of the Factory Insurance Association; see Fig. 3. These consist basically of purging, flame-proofing of the pilot and main flame, proof of air-fan and combustion-blower operation, high and low-gas-pressure switches, high-temperature cutouts, and proper venting on shutdown of the unit.[3]

In recent years pressure has been brought to bear on industry to install direct-fired air heaters in industrial plants. Direct-fired heaters are units in which the ventilating air is blown or drawn through the flames and, together with the products of combustion, is introduced in the area to be heated. The main arguments for the use of direct-fired units are less first cost, infinite degree of flame control, lighter weight, and higher efficiency of heat exchange. The main arguments against the use of these units are the fact that the products of combustion are introduced into the breathing area; that, in case of control failure, raw gas may be be blown into this same occupied area; and that recirculation of area air is neither safe nor practical.

It is apparent from an economical standpoint that the use of direct-fired make-up-air units must be considered. In order to safeguard personnel and property, certain precautionary measures will have to be built into the units and into the installation. On this basis it is imperative that each installation be evaluated on its own merits by competent engineering personnel.

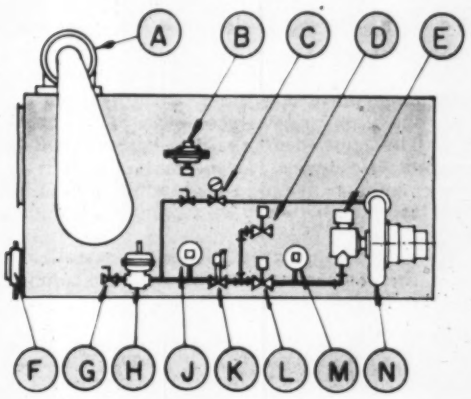
Conclusions

The design of industrial ventilation must be approached with an open, practical mind. The heated contaminated air rises to the underside of the roof; therefore that is the place to install the exhaust facilities. The comparatively cooler and cleaner outside air for make-up is most effective when introduced at a low level with sufficient control to benefit employees. Tight intelligent specifications, products by reputable manufacturers, and good field inspection during installation are prime requisites for a safe installation of industrial ventilation. Experience has proved that, within reasonable and practical limits, a safe installation is also a good installation and need cost no more than a haphazard one. The Lorain Assembly, Lima Engine, and Sharonville Transmission Plants of the Ford Motor

[1] However, even these can be improved. For years an automatic oil-bath filter was used for cleaning the air in a central-fan system. This required an oil clarifier, emergency drains, fire protection, and systematic desludging of the sump. The unavoidable spillage, leaks, and carry-over spread an oily film over the immediate area around the filter with its ever-present danger of fire. Recently the automatic roll-up type of filter with a fiberglass mat has been used almost exclusively. This installation, not using oil, eliminates the need for a clarifier system, drains, and fire protection and requires little maintenance other than the replacement of the filter media.

[2] How do you safeguard a potential bomb such as this? Listing by the Underwriters' Laboratories, Inc., and approval by the American Gas Association are a good start. Requesting a 10-year warranty on the parts that are in direct contact with the flame and/or flue gases helps to get material best suited for the application. Flame testing by the manufacturer before shipment eliminates a lot of field problems. An induced-draft fan insures positive purging and elimination of the products of combustion.

[3] In spite of all attempts to provide a safe unit, one serious accident resulted when a puff from incomplete combustion threw a relief door open. The piping to the gas pilot had been piped across the path of the door swing and was broken off. The resultant flame seriously burned an employee working on the unit. Field installation of the unit is of prime importance.



A FAN MOTOR
B AIRFLOW SWITCH
C PILOT SOLENOID VALVE
D N.O. SOLENOID VALVE
E TEMPERATURE CONTROL MOTOR
F TEMPERATURE CONTROLLER
G MAIN GAS COCK
H GAS REGULATOR
J LOW PRESSURE SWITCH
K SAFETY SHUT-OFF VALVE
L N.C. SOLENOID VALVE
M HIGH PRESSURE SWITCH
N MAXON AIRFLO MIXER

Fig. 3 The controls for gas piping approved by the Factory Insurance Association provide for purging, flame-proofing of the pilot and main flame, proof of air-fan and combustion-blower operation, high and low gas-pressure switches, high-temperature cutouts, and proper venting on shutdown of the unit

How SAFE is your INDUSTRIAL VENTILATION

Company are considered by the author to be prime examples of exceptionally well-ventilated industrial plants. In these plants the design, equipment, and installation are operational proof that industrial ventilation can be truly effective, safe, and still within project appropriations.

Equipment

The standards established for two of the units described in this paper are of interest. Some of the provisions for the Ford Standard roof exhausters are:

1 Throat and curb assembly shall be a one-piece spinning or a continuously welded assembly—this is to eliminate the leaking experienced with spot welding and bolting, and the looseness that has resulted from vibration and down thrust.

2 The gravity dampers shall be constructed of galvanized sheet steel. The damper axle-shaft shall extend the full width of damper and be securely fastened by rolling and/or riveting. The shaft bearing shall be Oilite, nylon, or Teflon. Dampers shall be spring or counterweight loaded with a 165-deg fusible-link release to open in case of fire. Aluminum dampers will not be accepted.

All of these provisions pertain to safety. Aluminum dampers have fatigued and cracked, dropping into the propeller. Stub shafts have broken or torn out of their skimpy mountings. Cheap metal-to-metal bearings have cut the axle shafts. Fusible release loading of the dampers allows the throat area to be used in smoke-vent area requirements.

3 The propeller shall be a one-piece aluminum casting or a die-formed sheet-steel assembly of continuously welded or riveted construction mounted directly on the motor shaft. Propeller tip speed shall be no greater than 10,000 fpm at full load rpm of the motor. Aluminum castings for propellers shall have the following minimum characteristics: 20,000-psi ultimate strength, 15,000-psi yield point, 2 per cent elongation. Propellers shall be statically and dynamically balanced.

Multipiece adjustable-pitch aluminum propellers have loosened, cracked, and broken. With the propeller mounted directly on the motor shaft, belts can't loosen and fly off or break. No one has to climb on the roof to adjust them. The tip-speed limitation allows the use of standard motors while keeping the speed well below the dangerous range and within acceptable noise limits. A balanced propeller adds life to itself and the whole assembly by keeping vibration to a minimum.

4 Access to and removal of the motor and propeller shall be from the roof to prevent under-the-roof maintenance with its inherent dangers to maintaining and operating personnel.

5 Each unit shall be equipped with a separate nonfused normal-duty disconnect switch in NEMA No. 3 enclosure mounted on the outside of the throat or on a bracket attached to the base. The motor shall be a totally enclosed air-over-motor type with heavy-duty sealed Life-Time bearings containing a suitable lubricant for continuous service and temperatures up to 150 F. The motor shall be securely bolted to its mounting using lock-washers, locking nuts, or castellated nuts and cotter keys. The bolts shall be the largest diameter that can be used with the holes in the frame feet. In case these holes are slotted, elongated, or out-of-round, the motor feet shall be doweled in at least two places on a diagonal.

A disconnect switch at the unit insures that no one will start it from below while someone is working on the unit. The motor and Life-Time bearings minimize required maintenance. The secure mounting of the motor prevents shifting with resultant propeller damage.

After extensive research, it was decided to pattern any possible future installations of direct-fired make-up-air units after a bulletin issued by the Department of Buildings and Safety Engineering, City of Detroit, dated March 16, 1959. The recent date denotes the currency of the problem. This bulletin has the concurrence and approval of the Bureaus of Safety Engineering and Industrial Hygiene and the Department of Health. The gist of the bulletin is as follows:

1 The equipment may be used only to correct a negative pressure condition within a building where exhaust fans are in operation—this eliminates any haphazard use of the direct-fired units for miscellaneous heating of occupied areas;

2 The total discharge of the equipment shall not exceed 110 per cent of the capacity of the exhaust system in conjunction with which it is used—this limit is considered practical within the limitation of equipment availability. Infiltration of industrial buildings decreases this percentage substantially.

3 The equipment may be installed only in buildings classified as industrial occupancies and each such unit shall have a discharge capacity of not less than 10,000 cfm—this controls the application of the units and establishes capacity to insure proper dilution of gas-air mixtures.

4 All air handled by the equipment, including combustion air, must be brought in from outside—recirculation of interior air is considered a potential hazard due to build-up of contaminated air and the possibility of an explosion.

5 The ratio of gas input to the total quantity of mixture discharged by the equipment shall not exceed 0.2 per cent—this limitation is another assurance to keep the dilution of air to gas to the prescribed minimum.

6 The equipment shall be electrically tied in with its corresponding exhaust system so that it can be in operation only when the exhaust system is in operation.

7 The equipment shall be provided with air-flow sensing devices so designed and installed as to shut off the gas burner upon failure of either combustion-air or main-air supply.

8 The equipment shall be provided with combustion safeguards, including quick-acting, manual-reset safety shut-off valves, and with combustion-air-gas interlocks.

9 The equipment shall be provided with both a thermostatic device (for normal operation of the gas-burner component) and a high-temperature limit control. The latter shall be set at a temperature not to exceed 120 F.

10 The equipment shall be so installed as to not raise the temperature of surrounding combustible material to higher than 160 F.

Items 7–10 are part of the control circuitry and are in line with the company's normal requirements and those of the Factory Insurance Association.

equipment-performance analysis

By James D. Quinn,[1] Mem. ASME

E. I. du Pont de Nemours and Company, Inc., Wilmington, Del.

At du Pont, recording equipment now provides reliable information on machine down time, a complete record of shutdowns for all reasons

In the design of processing or manufacturing systems, allowances are usually made for equipment down time to establish realistic output for attainment figures. An unexplainable difference often develops between the actual availability and the availability assumed during the design stage. While allowances of 5, 10, or 15 per cent of available time may have been made for repairs, cleaning of equipment, and similar reasons, the total nonproductive time including that for maintenance may be in the range of 35–50 per cent. This nonproductive time frequently includes problems created by both process chemistry and equipment maintenance. Only outage time attributable to the manufacturing equipment will be considered in the present paper.

It is a bit startling that high percentages of nonproductive time continue to exist in spite of the recognition of maintenance-down-time causes and the taking of corrective action. This can be particularly disturbing if considerable effort has been expended in method studies, time studies, and other studies to improve effectiveness. While these may have resulted in some improvement, for a number of reasons many other causes of machine down time may have been dismissed as being inherent, or may have been accepted as normal situations. Equipment shutdowns of very short duration, such as for machine adjustment or clearing a product jam, may not be considered significant individually. Collectively they can become important.

Within the past year study of three unrelated manufacturing units was undertaken at the author's company to establish all the reasons for equipment down time. In the first case over 1500 shutdowns were recorded and described during an 11-day period. Productive time represented 65 per cent of the available time or, to express it another way, 35 per cent of the time the equipment was not producing. During the second study, 2500 shutdowns were recorded during a 14-day period. The productive time in this case was 41 per cent with down time of 59 per cent. In the third study, during a period of 10 days, over 1700 shutdowns and down time of 50 per cent were recorded. Perhaps these are unusual conditions. It is certainly hoped they are.

Three items involved in nonproductive time will be discussed: (*a*) Potential equipment utility, (*b*) reduction of equipment down time, (*c*) equipment to facilitate study of down time.

Potential Equipment Utility

Before discussing "potential equipment utility," the "production side" should first be considered. The effectiveness of production planning often depends on a number of items that may not be considered or may not be too well understood.

The information available for sales forecasting may range from firm commitments to educated guesses or assumptions. More reliable information may be available concerning adjustment for inventory, economical lot sizes, and adjustments necessary to meet required delivery dates. In addition to these, it is very important that factual data be available concerning potential equipment utility or output to have both effective production planning and high utilization of equipment. If based on design capacity with a modest allowance for down-time, the conclusions regarding potential equipment utility could be too optimistic or, if based on previous performance, too conservative. Underestimating down time could lead to scheduling problems, and overestimating down time could lead to acceptance of conditions—many of which might be correctable.

When potential equipment utility is considered, certain restraints are established by design limitations. Reasonable life expectancy and reasonable cost must be considered. This may dictate that commercially available equipment be used that does not have all the features that the designer would like to include and that does not eliminate all possibilities of equipment maintenance or equipment shutdowns.

Material limitations, particularly in chemical plants, are sometimes as important as equipment-design limitations. For example, there are still many situations where wood-stave or steel tanks are the most logical choice, although it is known that some maintenance will be required after a relatively short period of operation.

[1] Consultant Supervisor, Maintenance Engineering, Engineering Department.

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equipment-performance analysis

Process and quality-control limitations may exist when the machine loading and machine speeds are well within design limits, and the restraint in this situation is the physical characteristics of the product being manufactured. Until improvements can be made in the composition or characteristics of the product, and the mechanical limitations improved, there is little that can be done to increase the rate of productivity. In this situation the effects of maintenance can be the most significant segment of process-equipment down time and, if the rate of production cannot be increased, it is possible that the down time can be decreased. Down time for mechanical reasons may include machine adjustments, minor repairs, or replacement of components, major overhauls, or unplanned failures. The total effect can be important.

When down time occurs frequently for the same reason, the condition may be due to poor quality workmanship or because of changes in operating conditions. In the latter case the equipment may be operating at two to four times its original rate. Although the original design may have been adequate, the incremental increases may have been so small and gradual that the total effect on components was not considered.

How Much Maintenance?

The actual need for equipment maintenance, particularly to avoid unexpected shutdowns, is an extremely important consideration. Preventive maintenance, which was unique in the 1930's, is now accepted as a sound practice in many industries but is frequently applied too often. In a recent review of a routine monthly inspection procedure it was found that 300 items were included, many of which required dismantling of subassemblies. Only three of these items required inspection at the frequency prescribed, and then only on a term basis to establish rate of wear under the particular set of operating conditions.

In cases of this kind, it should be determined whether anything is accomplished. Furthermore, if the mechanic assigned is not able to duplicate the original conditions in reassembly, he may introduce rather than eliminate maintenance problems. If insufficient information is available about past experience, the approach to preventive maintenance should be very conservative. Otherwise, an occasional planned shutdown is displaced by a high number of planned shutdowns requiring considerably more production-equipment down time.

Efforts to "increase equipment utility" are usually only as effective as the completeness of the information, and apparently there is no short cut. Adequate data and systematic analysis of these data must be accumulated to establish reasons for all equipment down time.

If down time for maintenance can be accounted for and separated, opportunity is provided to examine the conditions and to evaluate the possibility of increasing productivity through this route. The most important

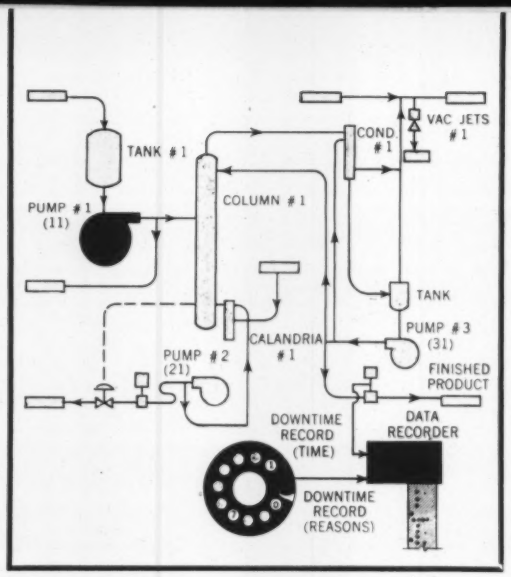


Fig. 1 An approximation of a typical process, showing how data on down time are furnished. When repairs have been made, an alarm in the recorder notifies the machine operator to dial the reason for the down time. The operator dials 1107 to indicate that seal failure coded as 07 in the pump coded as No. 11 was the reason for the shutdown.

effect of down time for maintenance could be lost production, but there is also the possibility of loss through substandard production, or both, resulting in a considerably higher product cost. If the number or frequency of maintenance problems is reduced, it may be possible to increase the rate of production as well as to increase available operating time.

Analysis of Data

"Problem solution" requires sufficient data and the analysis of these data by qualified personnel. The work should be undertaken by experienced engineers or, if engineers-in-training are assigned, they should have close direction. In the study, the adequacy of components for service at the present operating rates should be considered. Materials of construction now produced in higher volume at lower cost should be considered, as it may have been a marginal decision originally that they not be used. The effectiveness of maintenance procedures for repairs and preventive maintenance and the frequency that work is performed should be examined, if this information is available. It is not unusual to find that it is not.

Extensive programs for preventive maintenance involving considerable equipment shutdown and cost may be carefully scheduled to occur at 1-month, 3-month, 6-month, and 1-yr intervals without outlines of work to be performed other than a listing of inspection points. It will also be found that there is a tendency to inspect all equipment at least once a year—why, is not apparent. The same individuals who prepare these extensive programs would not dismantle and inspect all the equipment in their home at least once a year.

If study indicates that an investment should be considered to reduce equipment down time and action is taken, it is important that there be some method established to measure the results. Development of history concerning all reasons for production-equipment down time and the justification for corrective action can be very laborious and time-consuming. Most plant systems were not established with this requirement in mind and many sources may have to be used to develop sufficient data—cost records, shutdown reports, operat-

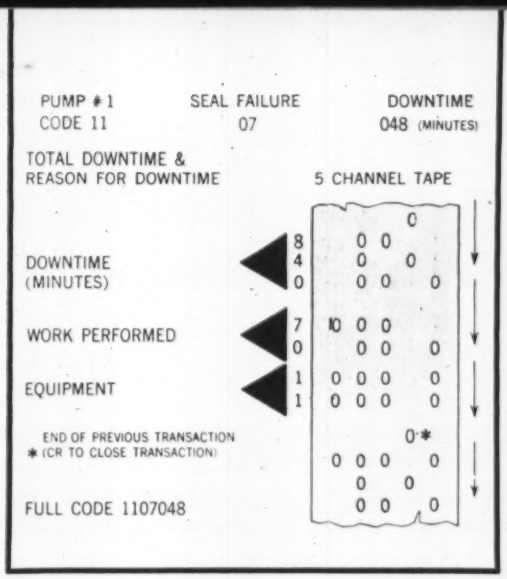


Fig. 2 The full code 1107048 appears on the 5-channel perforated tape. The first group to be recorded indicates the equipment on which work was performed. The second code group to be recorded indicates the work done. The final group indicates the down time in minutes. Measurement began when pressure dropped below accepted limit.

ing logs, and other records. Most equipment-history cards do not account for the numerous short-duration shutdowns because of the tremendous amount of clerical assistance that would be required.

Equipment to Facilitate Study of Down Time

About five years ago recording equipment, used for other purposes, that would provide information concerning equipment down time was investigated. It was found that a complete record could be accumulated of shutdowns for all reasons. However, the large number of components and reasons for shutdown had to be coded and then manually rearranged to accumulate time by reasons and to identify the most significant problems.

What was needed was a simple means of recording data and converting it to computer language so that the considerable amount of detailed information could be processed without clerical assistance. A market search revealed a considerable number of recording devices and suitable computers. Equipment that would bridge the gap between recorders and data-processing equipment could not be located, so a unit was developed to meet the requirements. Similar units will probably be on the market within the next year or so. Through extended use of the recording equipment, reliable information is being developed concerning all problems associated with operation of many process units in the plants.

While Fig. 1 is an artist's conception of a chemical processing system and will not stand close scrutiny, it illustrates how equipment of this type can be used. The recorder is shown responsive to a pressure-sensitive transmitter in the finished-product line, although in a mechanical application it could be actuated by a normally open relay in the power circuit when the circuit became de-energized. In the example, with a drop in pressure below an acceptable operation limit or with a complete shutdown of the unit, the recorder is energized and starts to record time. In this system of interdependent components pump No. 1 is coded as No. 11 to distinguish it from two other pumps in the system, and it is assumed that pump No. 1 failed because of a problem related to the mechanical seal. Upon replacement of the seal and start-up of the process, an alarm in the recorder is activated signifying that the operator is required to dial in the reason for shutdown.

The section of tape shown on the lower right-hand corner is enlarged in Fig. 2 to show how the complete data appear on the tape. Pump No. 1 is coded No. 11; seal failure is coded as 07, which can be one of 100 reasons for the unit. In this case, as many as 48 intervals of down time have accumulated. When the operator dials in 1107 to record location and cause, this is automatically encoded in the standard five-channel teletype code. Following the four digits being dialed in, a director-selector device takes over and reads and encodes the accumulated time. The process unit was down for 48 intervals for 1 min. A character, in this case, "carriage return," is automatically punched in the tape to indicate that the transaction is completed. Later, when the tape is processed through a tape-to-card converter, the character included permits transactions to be recorded individually on cards.

Machine sorting of the cards allows reports to be developed in any form required. This can be by all shutdowns related to specific units in the system, subassemblies, or components of these units; by all shutdowns of a particular kind that may be common, for example, to the three pumps in the system; and, of course, total down time for all reasons. Having the down time related to reasons and knowing the value of this time in terms of net sales dollars or other criteria, the justification for improvements can be evaluated.

The need for more detailed information about components of a system is being experienced now, and is becoming more important every day. There has been considerable discussion and written material concerning "automation" and process-pipeline systems, particularly in the past few years, but actually there has not been any radical change, it has been gradual. What has occurred is broader use of continuous processes or systems. This has brought about a greater need for high component reliability.

Objectives of System-Performance Analysis

In a paper presented in November, 1957, at an American Management Association Conference, H. T. Hallowell, Jr., president of Standard Press Steel Company, discussed the reliability needed for missile components, such as for the Atlas missile. He stated: "If the reliability of the components were all equal to the ivory-soap figure of 99.44 per cent purity, instead of over 300,000 separate components, the missile would have to be limited to 411 critical components to have one chance in ten of getting the missile to its destination." Although the author's company is not in the missile business, it is not unusual to have considerably more than 411 critical components in a system. To quote Mr. Hallowell again: "One of the fundamental obstacles that we must hurdle is the continued use of too much production-line thinking at a time that calls for more missile-age thinking." Missile-age thinking implies an all-out effort to improve component reliability and system performance through study almost as complex as the research project.

In the research project different routes and many different effects are created to compare or evaluate results. In system-performance analysis, information is at our disposal concerning cause and effect; the problem is to identify the cause. Knowing the cause, and correcting it, rather than accepting and correcting effects, appear to be a logical course of action to improve productivity.

Abstracts and Comments Based on Current Periodicals and Events

D. FREIDAY
Associate Editor

BRIEFING THE RECORD

Aircraft Jet in Stationary Use

AN ADAPTED aircraft jet engine is now pumping about 600 million cu ft of natural gas a day at the Possum Trot, Ky., pipeline compressor station of the Columbia Gulf Transmission Company, a subsidiary of the Columbia Gas System.

The RT-248 gas turbine, as the adaptation is called, develops 10,500 rotative hp and weighs 34,000 lb, about one sixth the weight of a conventional gas turbine. It is the first of a family of jet-powered gas turbines to be rated from 350 to 15,000 hp.

Designed by The Cooper-Bessemer Corporation of Mount Vernon, Ohio, the new gas turbine uses as its heat energy source a Pratt & Whitney Aircraft J-57 jet engine, adapted to run on natural gas. The J-57 drives a Cooper-Bessemer centrifugal compressor. Raw thrust of the J-57 section is converted to rotative power by a specially designed heavy-duty free turbine.

Almost 85 tons lighter than conventional gas turbines of equal power and efficiency, the RT-248 is designed to substantially lower installation, maintenance, and operating costs.

Its light-weight, 4000-lb jet-engine section, with 10:1 compression ratio, requires none of the extensive equipment, components, and piping of the regenerating systems, which are required with conventional gas turbines to reach acceptable efficiency. Nevertheless, thermal efficiency is claimed to equal or exceed that of all other gas turbines in operation today.

The RT-248 requires less than half the space, relatively simple foundationing, and much lighter crane facilities than regenerated gas turbines of equal power. Thus size and cost of a station building are greatly reduced.

Less than 4 hr are required to remove the jet-engine section and replace it, ready again for operation. Conventional systems require weeks of shutdown.

While an aircraft jet engine seemed ideal for this application because of its portability—original weight of 3950 lb was increased slightly in modification—durability under continuous heavy-duty operation was an unknown factor when development for stationary use began.

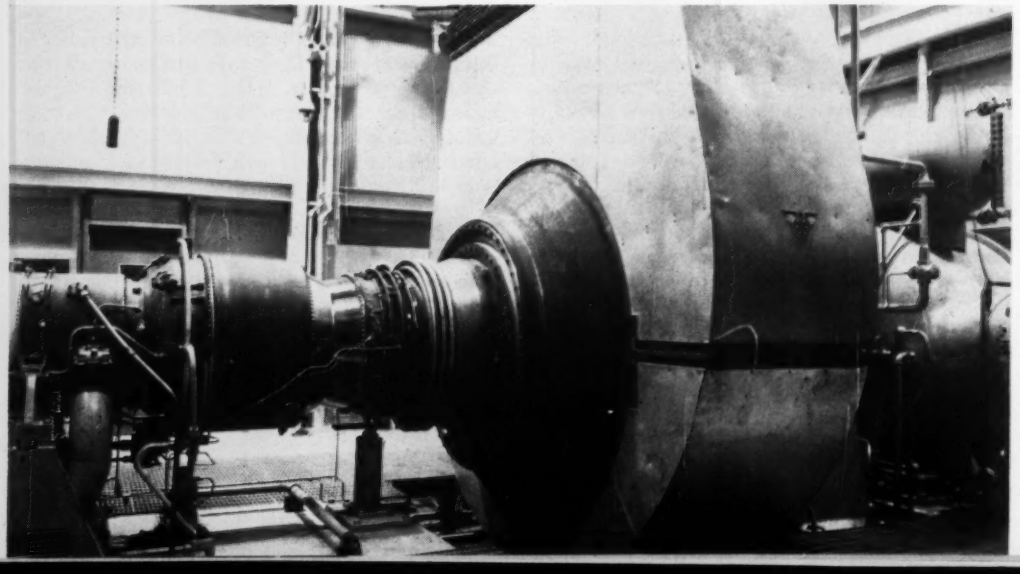
There was no appreciable experience with aircraft turbines in continuous operation. The punishment of sudden take-off, variable load, and frequent stops and cooldown was considered a much more rigorous treatment than continuous operation. The fact that aircraft turbines go in for overhaul every 1200 or 1400 hr was too apt to be used as an indication that this might be necessary in commercial usage. In reality, these are inspections, required since the engine is carrying lives and its condition must be known at all times. Not only are operating temperatures required for stationary use considerably lower, but much of the damage in aircraft use is caused by debris picked up on the runway and is not present in stationary operation.

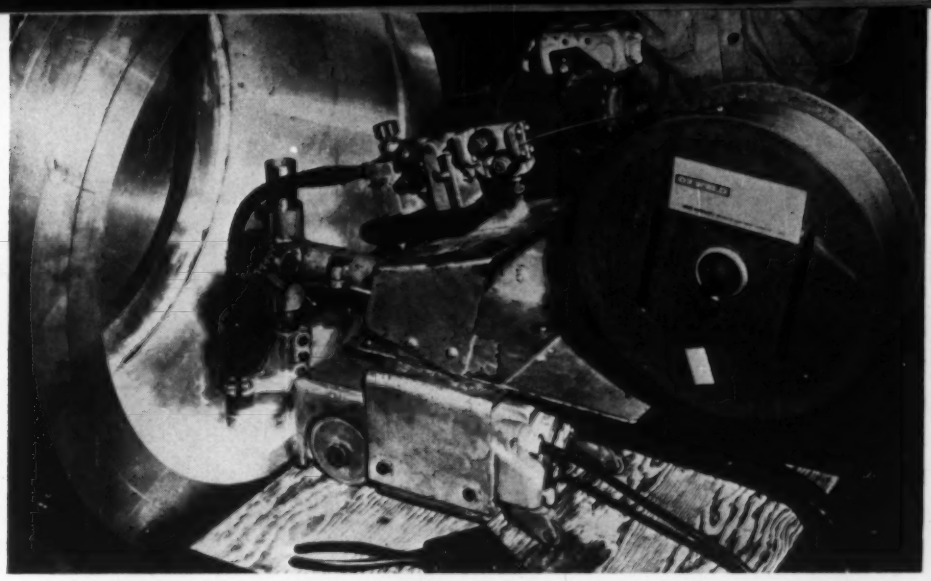
The adapted J-57 jet engine never reaches jet "take-off" speeds, temperatures, or stresses. It will operate at or below low-stress flight cruising speed. Results are low running temperatures and prolonged service life.

Designers estimate the jet section will run at least 8000 operating hours between overhaul, equivalent to a year's continuous operation.

Similar power plants are expected to find widespread use in the natural-gas, petroleum and petrochemical industries, in electrical power generation, and in marine applications.

Adapting an aircraft jet engine provided a stationary power source with only one-sixth the weight of conventional gas turbines. It develops 10,500 rotative hp to drive a centrifugal compressor for pipeline pumping, yet requires none of the extensive equipment, components, and piping of regenerating systems.





Fewer passes, less total heat input, and greatly increased speeds are claimed for a new "square-butt" welding technique. Heavy aluminum plate can be welded at over 400 amp.

Square-Butt Welding

HEAVY WALL aluminum cylinders for use in the nuclear industry are now being welded more economically, in fewer passes, with less total heat input, and at greatly increased speeds with "square-butt" welding.

National Steel and Shipbuilding Company, San Diego, Calif., achieves these startling results with Sigma welding equipment from Linde Company, Division of Union Carbide Corporation. Previous metal-arc welding of the $1^1/_4$-in-thick aluminum cylinders required: (*a*) Preparation of open-V beveled edges, (*b*) preheating with gas welding torches to 350 F, (*c*) welding one side of the joint then back-chipping and welding the opposite side, (*d*) several stringer-bead passes for completion.

Only the simplest joint preparation is required with the new method—a clean, square, end-to-end joint. Where minimum weld reinforcement is desired, a shallow V-joint may be used. Sigma single-pass welds, one from each side, result in full build-up and penetration. Radiographic tests show 100 per cent "water-clear" welds.

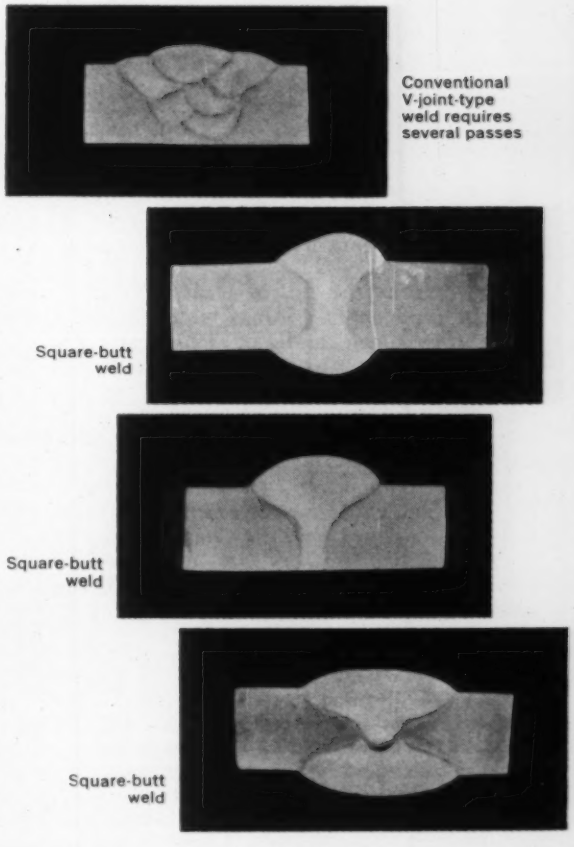
Square-butt Mig welding, also known as "high-current" welding, is a Linde engineering achievement which enables the welding of heavy aluminum plate at currents considerably above 400 amp. Prior attempts to exceed 400 amp resulted in arc instability, severe oxide folds between weld layers, and weld porosity.

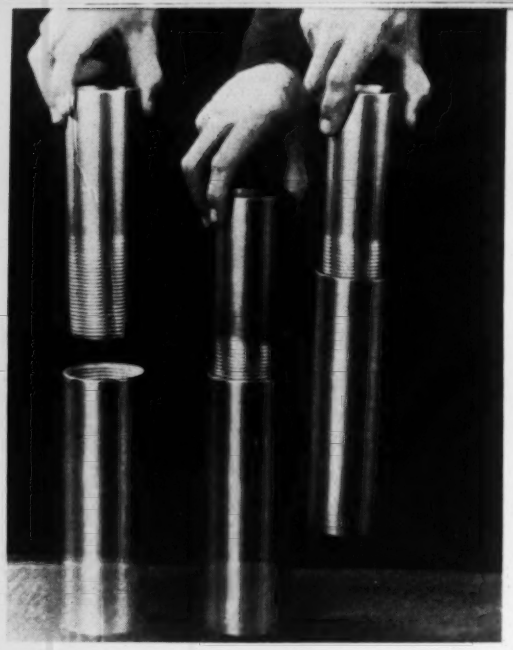
Square-butt welding incorporates improvements in gas shielding and purity, wire quality, and the slope-controlled power supply to overcome arc instability. Single-pass, water-clear x-ray welds are the result.

Sigma welding's higher currents (up to 600-amp, d-c reversed-polarity) increase heat input at the weld zone and eliminate porosity, since the puddle remains molten long enough for porosity-forming gases to bubble out. Yet, Sigma welding reduces total heat input, since only one pass is required from each side instead of several stringer-bead passes. The results are minimum distortion and reduced machining and scrap costs.

National Steel and Shipbuilding mounts 30-in-diam 6061 aluminum cylinders on a rotary positioner beneath an SWM-2 welding head. Joint edges of the $1^1/_4$-in. aluminum are square-machined for cleanliness and incorporate a $^3/_8$-in. chamfer, for minimum reinforcement. One-pass welds are made from each side at relatively low current (400 amp) and 27 volts, d-c reversed-polarity, using $^3/_{32}$-in-diam Oxweld 23 aluminum wire. Argon shielding flow is 100 cfh. Water-clear x-ray welds are made at a speed of 8 ipm.

Severe operating conditions for nuclear process equipment demand that all welds be free of cracks, pits, inclusions, or surface porosity. National Steel and Shipbuilding is meeting these high standards with Sigma square-butt welding at a remarkably low cost.





Walls at tube ends are no thicker than in the tube body with the use of "buttress thread," although the joint is as strong as the tubing body. Maximum clearance can be obtained when more than one string of tubing is used in an oil well.

Only 2 1/2 turns beyond the hand-tight position are required for a gas-tight joint. A torque of 900 ft-lb produces a power make-up of 2 1/2 to 3 turns, recommended for field use. Couplings can also be stabbed together on normal drop impact.

Buttress-Thread Tubing

A PIPE-THREADING innovation, called "buttress thread," of great significance for the production of oil-country tubing has been developed at the Lorain (Ohio) Works of National Tube Division of U. S. Steel. The new tubing has a rugged thread with a buttressed side differing from the old triangularly symmetrical thread.

Prior to this development, it was necessary to upset tubing before threading. Upsetting makes the walls at the tube ends thicker than the tube body. Tube ends thus maintain full strength after a standard thread is cut.

However, with buttress thread this thickening is no longer needed. Inherent support in the thread makes the joint as strong as the tubing body without making the tube wall thicker. Elimination of the upset, or thickened end, permits maximum clearance to be obtained when running more than one string of tubing in a well.

Elsewhere at the Lorain plant, specially prepared seamless pipe-coupling blanks receive an internal buttress-thread cut on the ID of each blank. The tapped couplings are electro tin plated and color coded as to grade.

Couplings are then applied to the tubing ends in the joint make-up operation. Each coupling, individually started by hand onto a corresponding length of tube, is then power tightened to a predetermined point.

Every coupled length receives a hydrostatic test which includes filling the tube with water and subjecting it and the coupling to internal pressures up to 15,000 psi. After this test it is stenciled, coated, and given thread protectors for customer shipment.

Algorithmic-Language Program

A NEW, high-speed algebraic compiler—claimed to be the first operating Algol (Algorithmic Language) program made available by a computer manufacturer—has been announced by Burroughs Corporation.

Devised for the Burroughs 220 electronic-data-processing system, the compiler accepts a machine-independent, problem-oriented language—permitting scientists and engineers to transmit their problems to the computer in nearly pure algebraic notation.

Thus the problem-solving abilities of the Burroughs 220 can be economically brought to bear on any algebraically stated problem.

Already in operation at more than a dozen Burroughs 220 installations, the new automatic programming system is designed to drastically cut programming time and problem-solving costs. Engineers and scientists can in a few hours attain sufficient mastery of the rudiments of the new system to allow them to state many problems for computer solution.

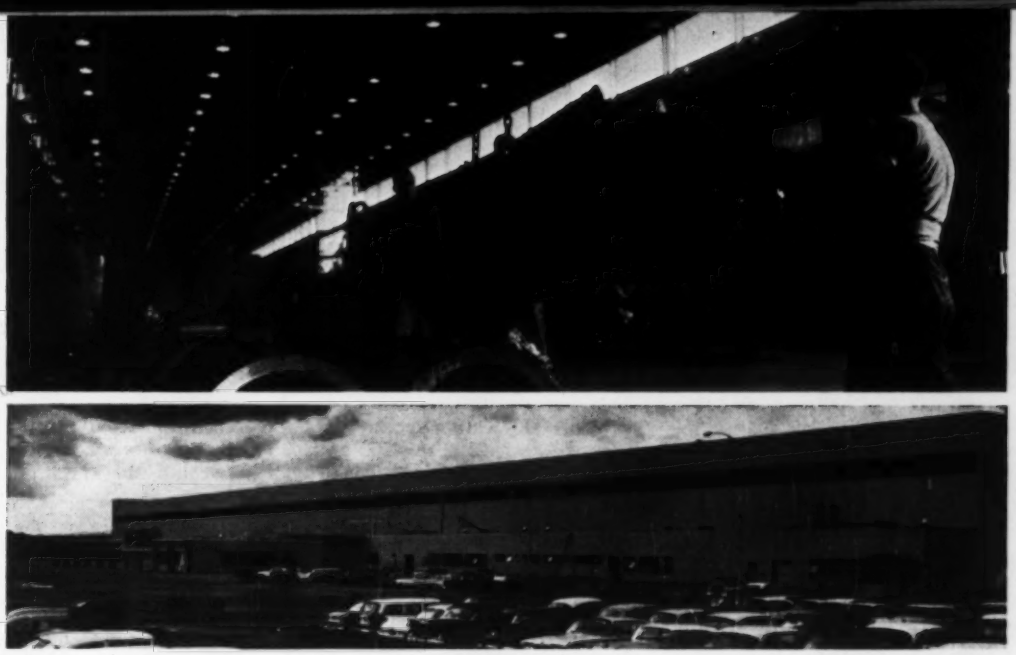
Besides offering high translation speed—an average of 500 machine-language instructions per minute—the Burroughs Algebraic Compiler provides computer-language programs which are nearly as efficient as laboriously achieved and handmade programs. This compiling speed is made possible by simplified one-pass internal operation. In addition, a one-load "compile-and-go" feature allows for immediate processing of compiled programs, eliminating excessive card handling.

Semiautomatic segmentation in the Burroughs Algebraic Compiler permits construction of a program in which the main body of the program becomes a master routine, controlling the operation sequence and memory assignment of program segments. Thus the compiler allows the computer to handle programs which exceed the available amount of storage.

Minimum Burroughs 220 system requirements for the compiler include 5000 words of magnetic-core memory; two magnetic-tape units; and a one-input, one-output unit Cardatron subsystem.

Built into the compiler are special diagnostic features, which control scanning of the source program for syntactical errors. These are listed without interrupting compilation, permitting maximum detection of errors.

Additional symbolic debugging aids provide for the monitoring of the values of variables during the running of the object (machine-language) program. A symbolic memory dump is also available at object time.



A 900-ft-long straight-through production-line sequence is used in The M. W. Kellogg Company Power Piping Division plant and headquarters at Williamsport, Pa. Fittings, pipe, and other materials are stored in a 40-ft-wide raw-materials bay which extends the full length of the plant. Metallurgical and welding laboratories as well as division headquarters are included in the 140,000-sq-ft plant.

New Power-Piping Plant

THE Power Piping Division of The M. W. Kellogg Company, a subsidiary of Pullman Incorporated, is now housed in new $4-million facilities at Williamsport, Pa., which in addition to manufacturing areas include completely equipped metallurgical and welding laboratories, and division headquarters, formerly in New York.

The 140,000-sq-ft plant has been designed specifically for efficient manufacture of power-piping systems for the electric, nuclear power, and process industries.

One-direction work flow is used in the 900 by 155-ft layout. Fittings, pipe, and other materials are stored in a 40-ft-wide raw-materials bay, which extends the full length of the plant. These materials are fed into the production line where needed.

Equipment in the metallurgical laboratory will enable Kellogg to perform tensile, impact, and hardness tests, at all ranges and temperatures. There will also be available equipment for making microscopic studies, supplemented by metallographic equipment for making records. Much of the effort in the welding laboratory will be devoted to development of automatic procedures for pipe welding carried out as part of Kellogg's continuing search for more efficient and more economic methods of manufacturing power piping.

Engineering, procurement, estimating, field-erection services, administration, and management are located in the office portion of the plant. Sales offices remain at 711 Third Ave., New York, N. Y.

Effect of Spin on Heat Transfer

HEAT transfer by natural convection may be stopped by spin.

The discovery was made by David Dropkin, Cornell University mechanical engineer, in connection with an Avco Corporation research program aimed at cooling space vehicles during re-entry.

Using cylindrical containers of various sizes, some as small as 1.39 in. high and 5.28 in. in diam, Professor Dropkin's research team is simulating conditions inside a space vehicle. The containers consist of $^1/_4$-in-thick chromium-plated copper plates top and bottom, and pyrex-glass sides.

Data are being gathered and information concerning various liquids compared in the hope of creating a formula that will enable space scientists to compute beforehand the amount of heat that will be transferred for a given rate of spin. The work also concerns other equipment where heat transfer is a factor.

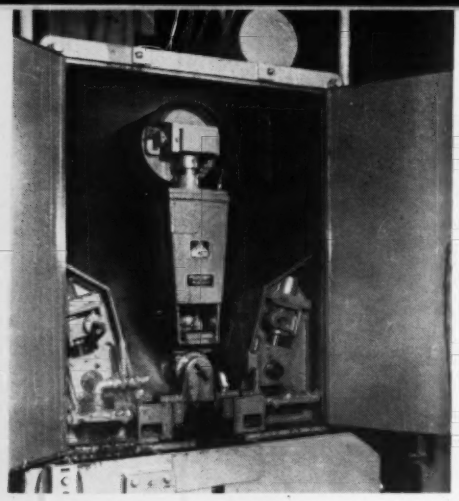
Professor Dropkin and his colleagues have shown that by introducing spin about a vertical axis an additional stabilizing force retards heat transfer by convection. With spin this stabilizing force (Coriolis force) acts on particles of the liquid having a horizontal velocity component, deflecting the particles perpendicularly to both axis of rotation and the particles' direction of motion.

In this process the closed streamlines followed by the fluid are lengthened. The dissipation of energy due to flowing is checked, and the time is lengthened during which conduction (as in a steel bar) can act to reduce disturbances of the stratified layers of the liquid of varying density—that might lead to convection heat transfer.

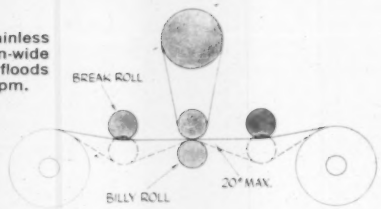
It has been shown that spin may have a second important effect on the onset of convection. When instability does occur in a moving object under spin conditions, the resulting motion may be oscillatory (swing from one direction to the other), rather than in a single direction.

The research indicates that it is possible to stop the heat transfer by convection when the proper spin, height of liquid in the container, and liquid-flow motion are attained. At this point the reduction of heat transfer begins and the convection is completely stopped.

This activity, according to the Cornell researcher, appears to be a function of the heat applied. Using mercury as the liquid medium, the researchers have succeeded in stopping transfer of heat by convection at a spin rate of 6 rpm when supplying a heat flux of 1725 Btu per hr per sq ft to the maximum point of density of the mercury.



Crown is removed from stainless strip at 4200 fpm with 30-in-wide coated abrasive belt. Oil floods each grinding head at 65 gpm.



Abrasive "Machining" of Stainless Steel

"MACHINED-QUALITY" stainless steel is being produced with an abrasive-belt grinding line at the Wallingford (Conn.) Steel Company.

The new equipment saves nearly two thirds of previous grinding costs. It adds a revolutionary benefit to fabricators and other users by holding thickness variation across the width of stainless strip to less than 0.0005 in. This unique crown-grinding feature enables Wallingford to become the first stainless-steel producer capable of supplying strip that will meet and improve on the exacting tolerances being specified for aircraft, missiles, and space vehicles.

The grinding line consists basically of two 60-hp vertical grinders running in tandem, each driving 30 × 126-in. cloth belts, all-resin bonded, with aluminum oxide or silicon-carbide abrasives. Unlike earlier dry-grinding equipment at Wallingford, these belts grind in a flood of sulfur-chlorinated oil pumped to each grinding head at 65 gpm (maximum capacity 100 gpm) from a 4000-gal reservoir and filtration system. When high polishes are required, less aggressive glue-bonded belts of cloth or paper will be used.

Several novel features combine to flatten the strip as it approaches the abrasive belt. The coil is under endwise tension of 30,000 lb, and it is sharply bent, at angles up to 20 deg, by being forced under "break" rolls as it approaches and leaves the grinding point. Also, an 8-in-diam solid-steel billy roll or work-support roll forces the strip against the belt by hydraulic pressure. With such heavy components, the machines can handle strip to 0.240 in. in thickness.

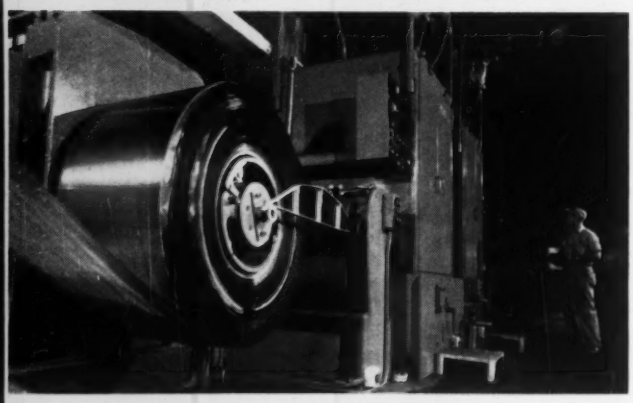
Contact rolls are knurled steel or serrated rubber, in a range from 45 to 90 Durometer, dynamically balanced. They operate at 900 and 1800 rpm to give belt speeds of 2100 or 4200 surface fpm. Work is fed to the abrasive belts at speeds usually between 6 and 36 fpm, depending on the depth of cut, type of stock, and the surface finish desired.

The two grinders, with their coated abrasive belts running in oil, were built by the Hill Acme Company according to designs modified by Wallingford's abrasives engineers and those of the Behr-Manning Company of Troy, N. Y., a division of the Norton Company. They represent eight years of joint development work, replace two former grinding lines which included five machines, and produce in one shift the stainless strip which formerly required three. At the same time, quality is substantially improved.

Another economy being realized with the new line is the ability to salvage entire coils which formerly had to be shipped back to the mill for remelting. Frequently, imperfections were too deep for the old dry-grinding lines to handle—a condition most commonly met with the exotic metals such as titanium and zirconium, and with special alloys.

Early estimates pointed to probable savings with the new line, in direct labor cost and that of abrasive belts of nearly $91,000 per year. It has already become clear that savings will exceed that rate. About 25 per cent of the plant's production will be found on the new line.

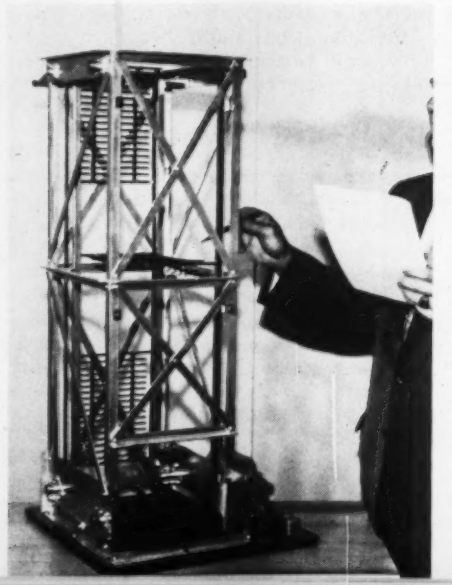
Maximum width of the stainless-steel strip abrasive ground at Wallingford Steel Company is 27 in. Protective paper is fed to the coil from the extreme left. Weight of a single coil often exceeds five tons.



Escaveyor

A NEW type of vertical conveyer, called an Escaveyor, has horizontal platforms formed from linked slats. These are attached to continuous chains to assume a space-saving vertical position on the return trip. Escaveyor is made by Standard Conveyor Company, North St. Paul, Minn.

Escaveyor's horizontal platforms are formed from linked slats. These are attached to continuous chains so they assume a space-saving vertical position on the return trip.



Claimed to be the only machine of its type on the market, Escaveyor is so compact that it actually takes less floor space than a monostrand or straight-lift conveyer.

Though fast, compact, continuous, and self-loading, Escaveyor generally costs less to purchase and install than other types of vertical conveyers.

Escaveyor is ideal for vertical movement of commodities in buildings in which freight elevators are too slow and lack of space prohibits installation of ordinary inclined conveyers. It may be used in up service, down service, or be made reversible.

Elastic Tie Downs

DELICATE electronic equipment is assured safe handling when moving in piggyback shipments. Damage losses on many types of units now being shipped by rail can be reduced. And some products previously restricted to other methods of shipment can now be transported by rail.

These are some of the implications of the new Lord Tylastic Tie-down System, now being shown to the railroads and industry by Lord Manufacturing Company, Erie, Pa.

Borrowing on extensive experience in vibration and shock-control systems and shipping-container mountings, the system is designed to provide gradual shock absorption by permitting the lading to move during impact. Equipment is elastically restrained on a flatcar by a small number (4 to 16 depending on the weight of the equipment) of elastomeric spring-and-cable (or chain) assemblies. During extreme handling operations where cars could be impacted at speeds of 8 to 10 mph, this system will absorb up to 90 per cent of the longitudinal shock force on the flatcar floor and prevent it from reaching the lading.

This effective shock-cushioning action is made possible by large deflection capability of the Tylastic Tie-down—it can deflect up to 20 in. under a 30,000-lb load (minimum breaking strength). This unusual flexibility plus high strength are realized through the use of a special sandwich-type elastomeric design. The elastomeric spring utilizes rubber permanently bonded between steel.

Bonded rubber was chosen because it provides the greatest shock-absorbing capacity for given weight and size; permits wide design freedom; facilitates design of light, compact, easily installed units; provides consistent protection in various shipping conditions.

Improving Human Components

"IT IS important that human characteristics be considered in deciding which functions in a closed-loop control system will be performed by the man, and which by electronic, electrical, or mechanical components." [1]

A "problem-making" analog computer and a control panel are helping researchers at Battelle Memorial Institute, Columbus, Ohio, to understand better the effects of automation on the men who supply the necessary human element in complex man-machine systems.

The study headed by technologists Ralph Thomas and Alan Pritsker is sponsored by Wright Air Development Division's Aerospace Medical Laboratories, a component of the Air Force's Air Research and Development Command.

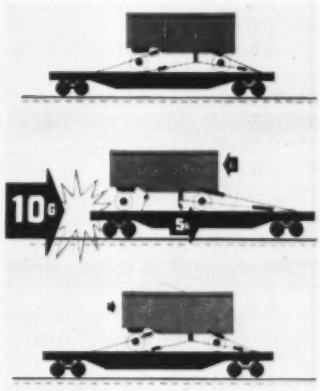
An array of lights and buttons simulates the kind of equipment which requires constant human attention in man-machine system such as a radar alert system or chemical-processing-plant controls.

The human subjects watch a delicately balanced needle of a dial mounted on the control panel. With the flash of a light, the operator may be asked to determine whether the needle is properly aligned on the dial. If it is not, he indicates, by pressing a button, whether the needle is high or low or pushes one of eight buttons to align the needle. Finally, the operator may be asked to indicate whether he was successful in realigning the needle by pressing either a button labeled "effective" or one labeled "not effective."

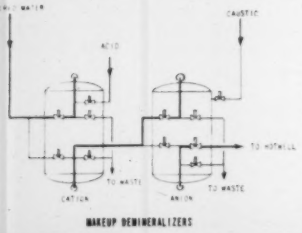
In effect, the control panel keeps the operator constantly alert to three questions: (*a*) Is the system operating as it should? (*b*) If it isn't, what correction should be made? (*c*) Was the action taken effective in correcting the system? These questions are basic to automation problems, and they will have to be answered in the control of systems no matter how sophisticated machines become. Indeed, with more complex automation systems, it will become increasingly important to designers to know how well, how quickly, and how often a man can be relied upon to answer these questions.

[1] H. P. Birmingham and F. V. Taylor, "Quickening for Finer Control," MECHANICAL ENGINEERING, October, 1958, p. 56.

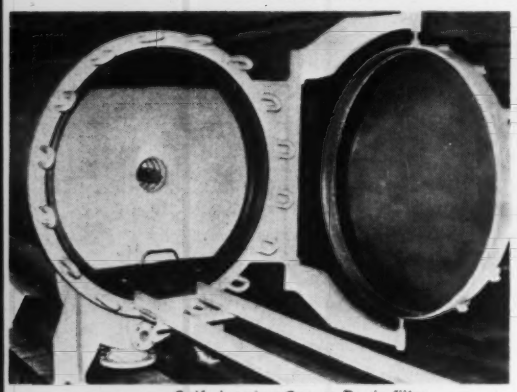
Elastomeric spring-and-cable (or chain) assemblies elastically restrain equipment on a flatcar. Gradual shock absorption is provided by permitting the lading to move during impact. The system will absorb up to 90 per cent of the longitudinal shock force and prevent it from reaching the lading.



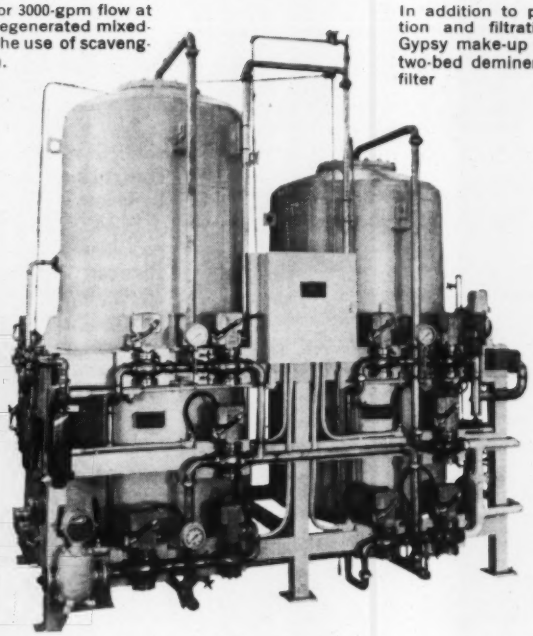
The high-rate condensate-scavenging equipment for 3000-gpm flow at the Little Gypsy Station consists of two externally regenerated mixed-bed demineralizers, and two Graver-Davis filters. The use of scavenging allowed for simplification of the make-up system.

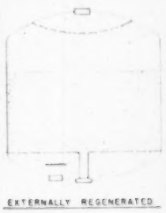


MAKEUP DEMINERALIZERS

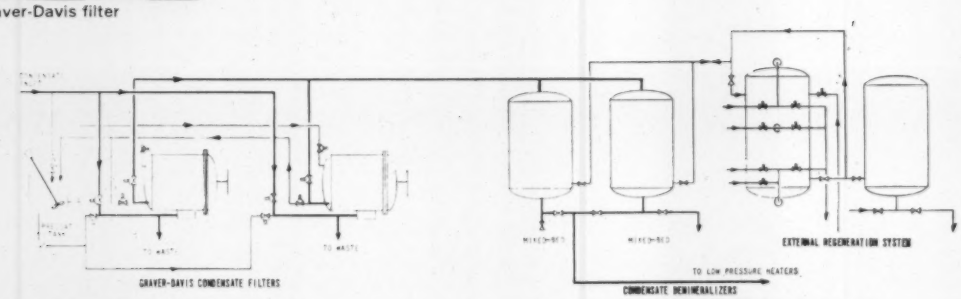

Self-cleaning Graver-Davis filter

In addition to pretreatment clarification and filtration units, the Little Gypsy make-up system consists of a two-bed demineralizer preceded by a filter


Make-up demineralizers



Interior design of demineralizer



Fow diagram for the Little Gypsy Station

Simplified Feedwater Treatment

A CONVICTION that too much attention has been given to extreme make-up purity in boiler feedwater requirements for high-pressure boilers, while condenser weepage or leakage and internal cycle corrosion—far more important sources of solids contamination—have been largely overlooked, has led D. M. Spillane and V. J. Calise, Mem. ASME, of Graver Water Conditioning Company, a division of Union Tank Car Company, to the conclusion that complete water treatment can be obtained only by condensate or feedwater scavenging, filtration, and demineralization.

In a paper, "The Place of External Regeneration in the Design of High Rate Condensate Scavenging Systems," presented at the 21st Annual Water Conference of the Engineers' Society of Western Pennsylvania, they state that it has become evident that a "giant step" of simplification in water treatment is in the making.

This will combine, they predict: (*a*) An economical high-rate condensate-scavenging plant working at the condenser hotwell to remove all impurities from the cycle; (*b*) use of steel-tube heat exchangers in place of copper alloy; (*c*) a simplified variation of "zero solids treatment," using ammonia and/or hydrazine for protection of steel surfaces against corrosion.

One of the essentials in this trio, a more economical condensate-scavenging plant, is possibly the key to the entire concept. This would include cellulose precoat filters preceding externally or in-place regenerated mixed-bed demineralizers with or without post filters, all designed for high-rate operation. The Spillane-Calise paper deals with the factors that influence the design of this more economical condensate-scavenging plant, and indicates the importance of external regeneration processes in making possible the practical consideration of condensate scavenging.

Contamination of boiler feedwater or condensate comes from four principal sources: (*a*) Make-up solids—solids which leak through the make-up purification system, and include electrolyte dissolved solids and, in some instances, colloidal silica; (*b*) condenser leakage—the introduction of detrimental suspended and dissolved solids through the condenser, which has been shown to be a major source of contaminants in the condensate in many instances, the degree depending upon condenser design and maintenance, and also upon the nature and concentration of solids in the cooling water used on the tube or cooling-water side of the condenser (in many central stations where seawater or brackish water is used

for cooling, a very slight "weep" in a condenser tube will introduce a concentration of contaminants that can be injurious within the sensitive high-temperature, high-pressure boiler system); (*c*) metallic corrosion products —suspended solids, generally created within the cycle itself as by-products of corrosion and erosion, which are an important source of contaminants to the condensate (precipitates of oxides of iron, copper, chromium, nickel, and others, in addition to the presence of the free metal itself); the use of both copper alloys and steel within the cycle has made it difficult to provide protection for both metals, so that it is advantageous to remove metallic corrosion products from the feedwater at a single point in the system; (*d*) fly-ash silica—the basic controlling constituent in the condensate and boiler system during startup and restart.

The complex nature of feedwater contamination makes it obvious that the extraordinary make-up purity frequently supplied at considerable cost with demineralizers or evaporators cannot be justified when condenser leakage or internal corrosion truly controls boiler-plant operation.

The usefulness of condensate purification systems has been well demonstrated with units for three separate once-through boiler plants, designed and engineered by three different water-conditioning manufacturers. These are the American Electric Power Philo Unit 6, Philadelphia Electric Company's Eddystone Units 1 and 2, and Cleveland Electric Illuminating Company's Avon Unit 8. Design and operating results were remarkably consistent, showing in all cases a great effect on feedwater purity. The condensate-purification systems were designed for between 20 and 50 per cent of total condensate flow, and demineralizers were in-place regenerated, preceded by cellulose precoat-type filters, for a flow rate of 2 to 4 gpm per sq ft to remove "crud." Demineralizer flow rates were in the 15 to 25-gpm-per-sq-ft range.

Positive elimination and effective control of all harmful impurities, including dissolved and insoluble impurities at the critical points of maximum heat exchange and potential contamination, can be achieved, as demonstrated by the three foregoing units, by means of high-rate condensate scavenging. Thermal efficiency can be increased up to 1 per cent by protecting turbine blades from deposits and removing corrosion products before they affect plant efficiency. Start-up is faster and boiler availability is increased. Blowdown is decreased or eliminated, and maintenance costs can be reduced.

To provide economic justification for condensate-scavenging equipment in subcritical conventional plants, a study was undertaken by Graver Water Conditioning Company to enable the reduction of the $2-per-kw cost of equipment for the Eddystone, Philo, and Avon units to under $1 per kw, preferably to the 50 to 75-cent range. This substantial reduction in costs was achieved by the substitution of externally regenerated demineralizers for the in-place regenerated type.

When 100 per cent condensate scavenging was installed at Little Gypsy Station, a drum-type boiler unit of the Louisiana Power & Light Company, it was found possible to eliminate the polishing mixed-bed demineralizers on the make-up demineralizer plant, revising it to a packaged prebuilt, simple, single-train two-bed demineralizer, from a dual-train unit. The cost per kw for the condensate scavenging equipment was 50 cents.

Equipment has also been installed at Huntington Beach Steam Station Units 3 and 4 of Southern California Edison for 75 cents per kw. Condensate scavenging equipment for the twin 600-mw Tennessee Valley Authority units, Paradise Station 1 and 2, which are equipped with once-through boilers, will be only 50¢ per kw.

Advantages in addition to lower equipment cost and reduced operating costs include: (*a*) No caustic or acid is used in the condensate stream; (*b*) less air contamination; (*c*) greater flexibility and increased availability of externally regenerated demineralizers.

Although additional horsepower is required for condensate-purification systems, if the total pressure drop across the system can be maintained at less than 65 psi, made possible by system design, the cost of adding and operating horsepower will be far from prohibitive.

Lignite Gasification Process

A NEW pressure gasifier being developed at the Grand Forks, N. Dak., Lignite Research Laboratory of the Bureau of Mines represents a significant step toward gasification of American lignite—both as a future source of chemicals and as a substitute for natural gas. The fixed-bed slagging-type gasifier operates on char, a partly carbonized lignite. Steam and oxygen react with the char to make product gas of good quality at high over-all efficiencies.

For the first time in the United States, this type of gas generator has been operated at temperatures high enough to permit discharging the ash as a liquid slag. Gas generators now in commercial use must discharge ash in solid form and consequently must be operated at temperatures below the melting point of ash to prevent formation of large lumps of fused ash.

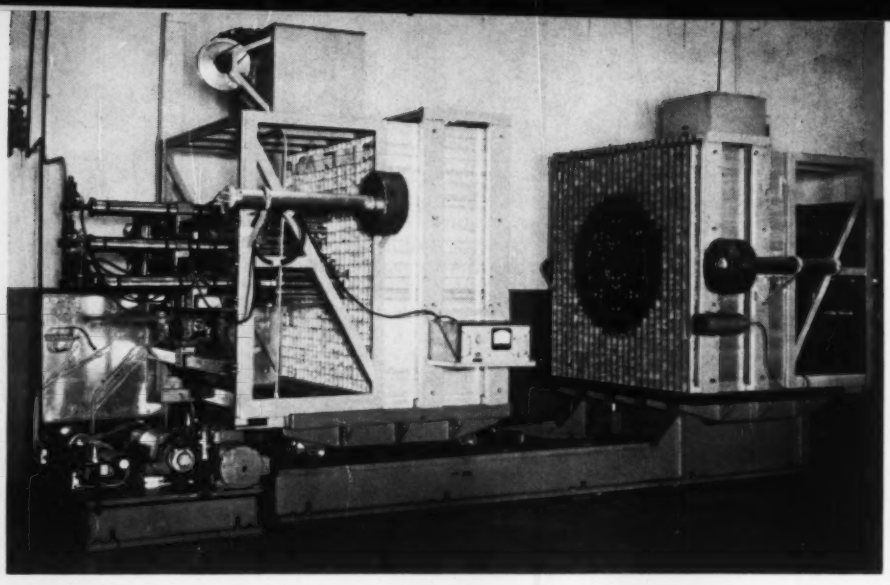
The Grand Forks experiments will continue for several months. They are required to develop a knowledge of process variables so that feed and slag-removal sections of the generator may be constructed to withstand much greater pressures for which its shell was designed.

Two further advances must take place before the generator can be considered a prototype for commercial development. It will be tested at pressures ranging from 370 to 450 psi, still using lignite char. Then, trials are planned with raw lignite instead of char in the generator, thus eliminating the char-making step.

In preliminary low-pressure test runs at 80 psi, operating efficiencies were "appreciably greater" than normally obtained in commercial operation of similar gas generators. Further improvement in efficiency is expected to come with operation at higher pressures.

The raw gas generated by the Bureau at Grand Forks is much like "water gas" made with ordinary coke and steam all over the world. It contains hydrogen, carbon monoxide, methane, moisture, and carbon dioxide in proportions that vary with pressures, temperatures, and rates of feed. Treatment of this raw gas yields "synthesis gas," a mixture of hydrogen and carbon monoxide, from which many valuable chemicals, as well as synthetic liquid fuels, may be obtained. This gas also may be reacted to produce methane, the principal ingredient of natural gas, a household and industrial fuel in many parts of the United States.

In Europe, since the 1930's, gas generated from "brown coal" similar to lignite has been used as a source of chemicals and as a fuel in certain locations where it is plentiful. The 350 billion tons of North Dakota lignite, plus the 113 billion tons in other States, if gasified, could be transmitted easily by existing natural-gas pipelines and supply part of the nation's fuel needs for centuries.



For studies of solid-moderated reactors, half the core is assembled on each table. The unit operates when the left half is brought into contact with the right portion.

A Nuclear Analog

WHILE in principle the reactor physicist should be able to calculate all of the characteristics of a reactor, in practice the mechanics of neutron motion and interaction are too complex. As a consequence, approximate theories are developed and simplified to a form that can be solved mathematically.

These simplified approximate theories, however, cannot give uniformly accurate results when applied to many different situations.

The use of the critical assembly in an experimental program to provide the data which normalize the theoretical procedures is described in an article by Joel W. Chastain, Jr., "The Critical Assembly—A Nuclear Analog," in the September, 1960, issue of the *Battelle Technical Review*.

Once initial conditions have been determined by preliminary calculations, parameters in the theory can be adjusted on the basis of experiment. The theory can then be used with more confidence to interpolate or extrapolate to conditions not specifically covered in the experiments. The process can then be repeated in a search for an optimum design.

Hexagonal fuel elements are assembled in a reactor-core tank. Data are taken from wires and strips placed about the core.

A critical assembly is the most effective means for obtaining accurate physics data.

What a Critical Assembly Is. It is a nuclear mock-up or simulation, in full scale of the geometry and materials of the reactor core and reflector. The name derives from the fact that the assembly of fuel and other core components can attain a critical condition, that is, can attain a self-sustaining chain reaction. Since the amount, type, and arrangement of materials are the same as in the planned prototype, when the system is critical, factors such as flux and power distributions are identical to those initially existing in the prototype reactor. Consequently, the critical assembly is an effective analog device from which physics data can be obtained.

The fissioning rate, the rate at which the chain reaction proceeds, can be adjusted to maintain the mock-up critical at a very low power level, say one watt or less. Since the intensity of the gamma and neutron fluxes is proportional to the power, the radiation level is quite low and requires relatively little shielding. Furthermore, at the low heat-generation rate, heat removal is not required. Most critical experiments are conducted close to room temperature which, along with the low heat flux, means that specifications on materials, methods of assembly, and dimensional tolerances can be relaxed. All these factors help to reduce costs and make the experiment much less expensive than use of a prototype reactor for the same purpose.

Design of Assembly Is a Compromise. In designing a critical assembly, one must reach some compromise between extreme flexibility and exact duplication of the prototype. Considerable flexibility to permit variations in loading and configuration of core and reflector is essential in the early stages of a program. On the other hand, the system must simulate the reactor rather closely or the data will be of limited value.

The areas in which exact duplication is used must be weighed against the value of the data and the cost of obtaining it.

Most critical assemblies are used for reactor design, although there are other uses such as obtaining basic physics data or investigating fuel-storage or shipping problems.

The preliminary design of the prototype reactor is simulated rather carefully, perhaps including the materials used to control the fission rate, for example, the

control blades. Parameters such as core configuration and fuel loading can be varied, but basically the experimenter obtains specific information for use by the reactor physicist and engineer in designing the power reactor.

"Pure geometry" or "clean" assemblies are not mock-ups of specific reactors; rather they are idealized assemblies of moderator, fuel, and structural materials operated at critical conditions with all control blades removed from the core to produce simple geometries that can be attacked analytically. Such assemblies must be reproducible and have considerable flexibility.

The critical assembly serves primarily as a method of obtaining information on nuclear performance. The experiments attempt to optimize the design from a physics standpoint, realizing that in the final design metallurgical and heat-removal criteria must be considered.

Working with certain variables and within the limits imposed by materials and heat transfer, the assembly is utilized to yield specific data on: (*a*) Fuel enrichment, quantity, and arrangement, (*b*) size of core, (*c*) power, and flux distributions, (*d*) control-rod worth, (*e*) effect of adding fuel, structural material, and so forth, (*f*) temperature coefficients and other basic-physics parameters.

In the initial phase of the program, the mass of fuel required to make the assembly critical in the clean condition (with no fission products) is determined by a stepwise addition of fuel elements to the core in an arrangement specified by initial calculations. Various fuel-element spacings and distributions of fuel within an element may be tried in an attempt to lower the fuel requirements or to obtain a more advantageous arrangement. Power and neutron flux distributions are determined by measuring the neutron-induced radioactivity of foils placed in the assembly. Based on these measurements, further changes in fuel arrangement or moderator-to-fuel ratio may be desirable to flatten the power distribution. With flattened or uniform power production the maximum power can be removed from a given core with a uniformly high outlet coolant temperature from all coolant channels.

Studies of flux distributions, with and without the use of a reflector—a material which scatters neutrons back into the core—can reduce the size of the core appreciably. Other experiments will determine the effectiveness of various types of control rods.

Future Use. Many reactor experts believe the critical assembly may become a more, rather than a less, important device in reactor design. The nuclear-analog aspect of the critical assembly makes it possible to obtain specific design information more accurately and actually more quickly than by multigroup calculations. Frequently, the experimental data can be obtained at a lower cost.

As the quantity of design information increases, certain reactor types can be built without prior experimentation. Semiempirical techniques based on the wealth of experimental data will be capable of determining the design with sufficient accuracy. However, new reactor concepts will undoubtedly continue to use critical assemblies.

Critical assemblies can provide reactor information more quickly and accurately and in less time than any other method. Consequently, they will continue to be used for many years in conjunction with machine calculations to arrive at an optimum design.

Fuel Washing

The Atlantic Refining Company has developed an automatic fuel-washing system for the processing of bunker fuel which promises important savings in the operation and maintenance of ocean-going vessels. The system was announced by W. A. Walls, port engineer of Atlantic's Marine Division, at a recent meeting of the Society of Naval Architects and Marine Engineers.

The higher temperatures and pressures at which modern ship's boilers must operate cause slag from impurities in the heavy bunker fuel to build up on the interior heating surfaces, thus requiring frequent and costly repairs as well as numerous delays in the sailing schedules.

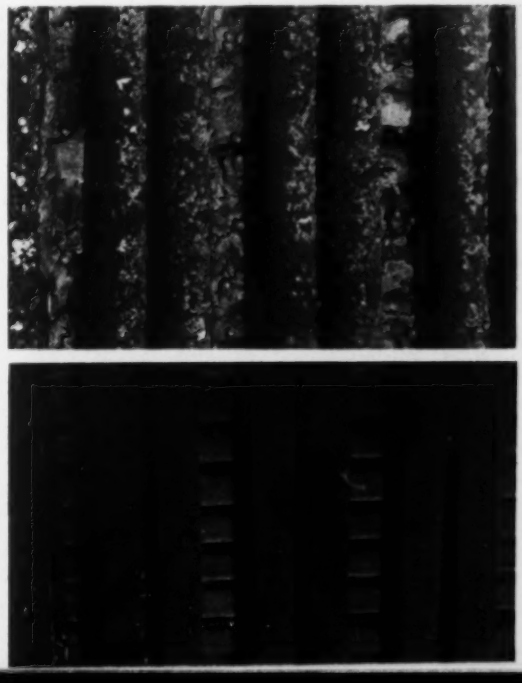
After 12 months of test operation with the new equipment on the *S. S. Atlantic Seaman*, the boilers were given a final inspection, and there was little or no build-up of slag deposits. It is conservatively estimated that savings from this technique will exceed $\$^1/_2$ million over the life of a supertanker, and additional installations are being made.

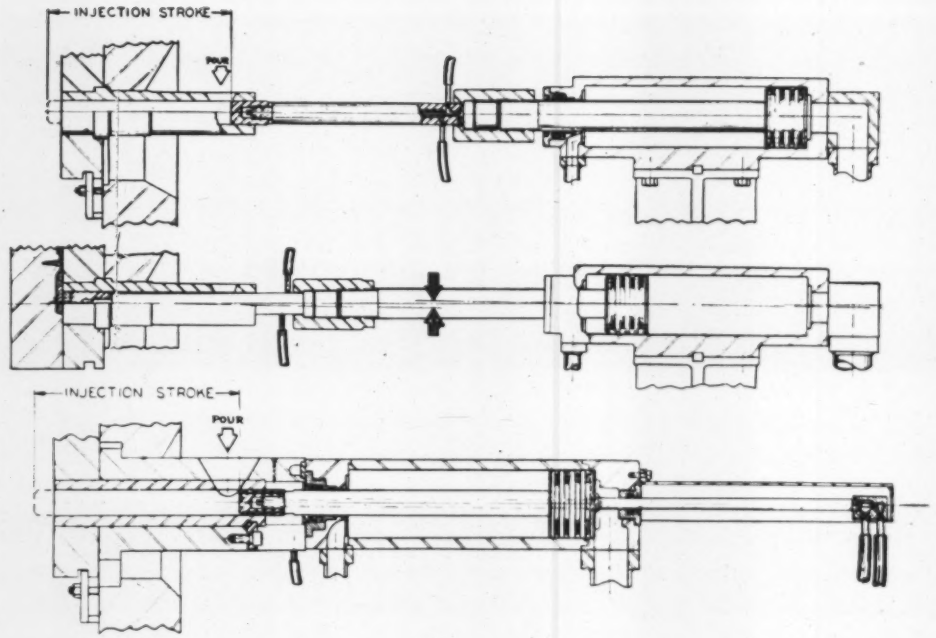
In typical operation the fuel-washing unit, used principally for the removal of sodium, is started up as soon as fuel has been taken aboard. Once on stream the unit operates at a rate slightly above that of the actual fuel consumption.

The raw bunker fuel is taken first through strainers and then fed into a charge pump where a small quantity (1 gal per 140 bbl) of demulsifying chemical is added. The fuel then passes through a continuous heater and, at a temperature of about 200 F, goes into an oil-wash mixer where hot water is introduced at a 5 per cent volume to dissolve the soluble salts. This mixture is next fed to a special Gravitol Centrifuge which was supplied as a package unit by the Sharples Corporation of Philadelphia. At this point, under high centrifugal force, the separation of the oil and the water takes place, and the water phase carries with it the soluble salts. The washed oil is returned through a cooler to the storage tanks.

Completely automatic, the system requires no additional ship's personnel. It is highly compact and occupies an area of only 10 sq ft.

Slagged condition of superheater before cleaning and prior to the test program is contrasted with its condition after testing with the fuel-washing system for a total of seven months





Old type of die-casting machine used an injection system consisting of a shot sleeve or magazine into which metal is ladled through a pour hole. Misalignment, **center diagram,** can develop for a number of reasons.

New type of close-coupled shot system is short and rigid and the cooling lines are unexposed

Die-Casting-Machine Injection Systems

SINCE the injection system which injects the molten metal into the die is really where the die-casting is born, it is important that it be designed and constructed to the highest degree of perfection. Two new types of systems proposed by Heinz C. Wernecke, Mem. ASME, chief design engineer, Kiekhaefer Corporation, in an article in the September, 1960, *Die Casting Engineer*, will improve production, density, and quality of castings.

Most die-casting machines used for the casting of aluminum, brass, or magnesium use an injection system consisting of a shot sleeve or magazine into which metal is ladled through a "pour" hole. This sleeve extends into the die and is carried on the stationary platen of the machine. A register ring prevents lateral movement.

Into this shot sleeve is fitted a plunger tip that pushes the metal into the die cavity. To this tip is attached a plunger rod which contains water-cooling passages that run into the tip to keep the tip cool and prevent seizing.

Materials Briefs

▶ Plastic-Lead Compound Can be Applied with Trowel

A 94 PER CENT lead and 6 per cent thermosetting plastic compound which requires no flame, heat, or pressure in its use is available from E. P. Barrus, Ltd., London, England. As reported in Armour Research Foundation's *Industrial Research Newsletter*, it is worked when soft and becomes tough and rigid in about 3 hr after application of hardening agent. Originally used in the repair of lead-lined tanks and sometimes applied with a trowel, it can be sawed, drilled, or machined like ordinary lead after it has hardened.

▶ Thermally Determined Magnetic Properties

A metallic compound with unique on-and-off magnetic characteristics has been discovered by the du Pont Company.

A brittle, gray manganese compound—chromium manganese antimonide—it becomes magnetic as the temperature rises above a point predetermined by its chemical composition (this can be varied over a temperature range of several hundred degrees). When the temperature drops below that point it becomes nonmagnetic.

The material was discovered by du Pont scientists engaged in fundamental research on magnetism, and applications have not been determined.

The compound's abrupt magnetic change occurs because the distance between its atoms determines how the inner magnetic forces are lined up. When the distance is less than a specific length, the forces are aligned in a nonmagnetic pattern; when it is longer, they swing into a magnetic pattern. The compound contracts and expands as other substances do, and its range of contraction includes the dimension at which the magnetic forces shift. Hence temperature brings about the magnetic change.

▶ Metal-Forming Lubricant Effective to 2200 F

Phosphatherm RN, a metal-forming lubricant for use between 1100 and 2200 F, is announced by the Alpha-Molykote Corporation, Stamford, Conn. Developed by the largest steel manufacturer in Germany, the lubricant is said to prevent galling, scoring, and metal pickup when forming most types of common steels, steel and copper alloys, and the exotic metals at elevated temperature where conventional lubricants are often ineffective.

The new lubricant is an eutectoid, a gradually soften-

The plunger rod is loosely coupled to a hydraulic injection cylinder which is mounted on its own adjustable support to permit moving the injection system up and down as different die conditions warrant.

To make castings of high density, the metal must be injected at great speed and under pressures that often reach over 35,000 psi. Misalignment between the injection cylinder and the shot sleeve or magazine can develop for a number of reasons. For example, a weak cylinder support could sag under pressure, the piston rod could be bent, the coupling could be eccentric, the shot sleeve center might not coincide with the injection cylinder center, and, finally, if the shot sleeve were improperly mounted in the die or machine, this would cause misalignment in the injection system.

In addition to speed and pressure, the injection system is subjected to 1200 to 1900 F heat which causes the shot sleeve to expand and requires cooling of the plunger tip to prevent it from seizing (or binding) to the shot sleeve.

Improper alignment causes the plunger tip to scrape and score both the tip and the shot sleeve. This scoring causes a very slight hesitation in the injection of the metal, which greatly affects the quality and density of the casting. In addition, it causes premature destruction of the tip and shot sleeve. When excessive scoring takes place, the metal soon spits back through, between the tip and the sleeve. Then the tip and sleeve must be replaced.

Since alignment is such a large factor in the function of the injection system, a close-coupled type has been developed. In this system the injection cylinder is mounted directly and concentrically to a shot-sleeve holder, which is carried by the stationary platen of the machine without any additional cylinder support.

The plunger tip is cooled by the hydraulic fluid that is used in the injection cylinder. It passes through an orifice, or check valve, into the tip, back through the cylinder rod, out through two small holes through the heat exchanger to the hydraulic fluid reservoir.

The cooling of the tip by hydraulic fluid such as oil or noninflammable fluids is less drastic or shocking than with water. In addition to this, the circulation of a small quantity of fluid through the injection cylinder keeps the temperature of the fluid in the cylinder at a moderate level. This keeps the cylinder seals and packings from becoming brittle from extreme heat. In water-cooling systems, passages sometimes are clogged by lime deposits which would be avoided by hydraulic-fluid cooling.

The close-coupled injection system is short and rigid, provides positive alignment, moving parts are safely guarded, the shot sleeve is changed without removing the die, no external supports are needed, maintenance and height adjustment are simple, and there are no exposed cooling lines. The installation is adaptable to existing machines, complete units are interchangeable, and there is provision for an automatic tip lubricator.

Explosive-Hardened Railroad Frogs

RAILROAD FROGS, which guide train wheels from one track to another, are made of austenitic manganese steel, a material which can be forged or cold rolled to improve strength. Since it is not susceptible to hardening by heat-treatment, there has been no known means of hardening in depth. The pounding of railroad wheels was relied on to surface harden the frogs for a life expectancy of about three or four years.

Experiments by New York Central research engineers described in the November, 1960, *Steelways*, use $3 worth of explosive hardening to quadruple the lives of frogs whose replacement cost is $1200 plus labor and lost-time charges. In 0.000001 sec the explosive shock wave produces a 2-million-psi peak pressure.

Increases in the hardness of manganese steel have been detected 2 in. below the surface, and it is believed that tensile strength can be more than doubled if a large enough charge is used.

ing mixture of certain phosphates and other salts, supplied as a dry white powder which forms a viscous liquid when mixed with ordinary water. On sufficiently hot surfaces it forms an adherent, spreading melt having excellent lubricity on both forming tools and materials being formed, especially alloy steels.

When dissolved in water Phosphatherm RM may be applied by brushing, swabbing, or dipping. The dry powder may be applied directly to surfaces over 400 F. The powder may be pressed into special shapes with or without a binder for insertion into die cavities. It may also be packaged in polyethylene bags containing measured amounts. The bags will disintegrate in use without interfering with the work. Lubricant residue may be removed from the surface with cold water. Both the solution and the powder are nontoxic, comprise no fire hazard, and generate no smoke or fumes.

▶ Corrugated "Honeycomb Core" Has High Strength

A honeycomb-core material with high strength and dimensional stability could greatly expand design concepts based on sandwich-panel construction, it has been announced by General Grid Corporation, Edgewood, Md., originators of the unique design.

Called Trussgrid, it is composed of cross-laminated layers of corrugated alloy 5052 Alcoa aluminum foil which alternate at 90 deg. Thus channels in alternate layers of foil run in the same direction, providing strength and rigidity in three planes.

Where the load is light, as in wall partitions, the rigid core can be used without structural facing. In thin-faced sandwich panels, the high-strength core can carry a large share of the flexing and compression loads.

On an equal-weight basis, Trussgrid resists 25 times more crushing force—applied perpendicular to the cell axis—than conventional hexagonal honeycomb core. This makes it desirable for use where load application cannot be controlled and promising for such applications as the leading edge of airfoil sections.

The material can be shaped readily by roll-forming and by crushing. It has excellent machining characteristics. Cell reinforcement—usually in the form of ice, resins, or waxes—is not required to permit efficient machining.

Trussgrid's natural venting characteristics promote bonding with all types of adhesives without perforating cell walls for the escape of gases. A rapid free flow of air made possible by the core's unique design offers a natural duct for aircraft boundary-layer-control applications. The material's open construction also makes it readily adaptable to internal fuel storage.

Automatic Freight Lift

A FULLY automatic vertical lift has been installed in New York's largest pier—Bush Terminal's Pier 6—to transport cargo to and from a storage loft where it is kept between shipments.

The new installation, designed by Gifford-Wood Company, Hudson, N. Y., consists of a lift car, five servicing conveyers, and controls. One of these conveyers, called the "car conveyer," is located on the lift itself. The other four, called "floor conveyers," service the car conveyer. There is one at each side of the lift on the ground floor and one on each side on the loft floor.

Any sequence of operations involved in loading from right or left floor conveyers on one level to either right or left floor conveyers on the other level can be preset in a master control board on the main floor.

As soon as a fork-lift-truck driver lowers a loaded pellet to a floor conveyer, its weight trips a limit switch. This activates a timer which delays any movement of the conveyer for 10 sec, allowing the driver enough time to pull away.

Then, both the floor and car conveyers are in action. The floor conveyer feeds the draft to the car conveyer. As soon as the far edge of the draft reaches the far edge of the car, a second limit switch is activated, stopping all movement of the two conveyers.

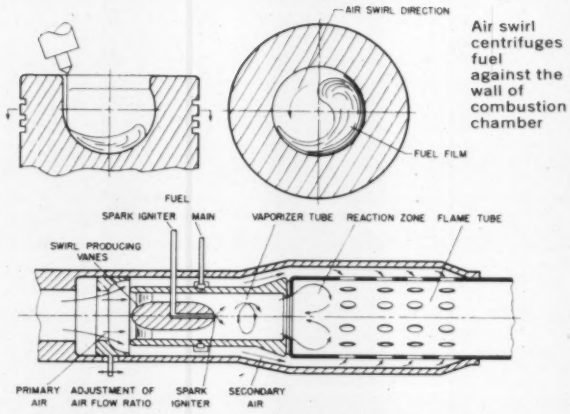
The car then begins its ascent. As it does, the doors on the main floor begin to close and the doors in the loft begin to open.

When the car reaches the loft level, a similar sequence in reverse, controlled by limit switches, feeds the load from car conveyer to floor conveyer at the loft level.

Safety provisions include an electric-eye system as a double check, and interlocking limit switches prevent the floor conveyers from attempting to feed the car conveyer when it is inaccessible. The electric eye stops all operations if a bag or box falls off during operation.

Additional safety, from falling loads and fire hazards, is provided by a cinder-block enclosure which will confine a fire to the car shaft if it starts.

A lift car, five servicing conveyers, and controls constitute a fully automatic vertical freight lift that can be loaded from either side. It also incorporates more safety provisions than ordinary lifts.



A film-vaporization combustor for gas turbines would increase the rate of mixing of the fuel vapors and air

Film-Vaporization Combustion

A RESEARCH prototype combustor for gas turbines has been designed on the basis of a film-vaporization principle already successfully applied to diesel engines.

As described in the November, 1960, *SAE Journal* in an article by A. W. Hussmann and G. W. Mayback, it is based on the M-combustion system invented by J. S. Meurer for diesel engines, and described in the September, 1955, *SAE Journal*.

In contrast to conventional diesel combustion of atomized fuel, the fuel is not atomized in the M-system but is spread as a film on the relatively cool wall of the combustion chamber. A vigorous air swirl with a peripheral velocity in the direction of the fuel jet helps to centrifuge the fuel against the wall and so spread it as a film.

The inherent advantage of prevaporizing the fuel from a film rather than from droplets lies in the fact that a comparatively large relative velocity between the fuel and the primary air can be maintained when the fuel is spread as film. If the fuel is atomized, an initial relative velocity between the fuel droplets and the air will very quickly diminish to a negligible value because of the large drag of the droplets, and the droplets will float in the air with a velocity approximately equal to the air velocity. A large relative velocity between the fuel and the air increases the heat-transfer and mass-transfer coefficients at the liquid-gaseous interface, and increases the rate of mixing of the fuel vapors and the air, thereby reducing the length required for the vaporization section and for the entire combustor.

A further and most important advantage of film vaporization is the fact that the fuel and fuel vapors can be kept below the cracking temperature during the mixing process.

Gas-Turbine Package Power Plant

GENERAL ELECTRIC recently announced a self-contained, factory-assembled gas-turbine package power plant which can be purchased for $100 per kw and can be in operation 10 days after delivery.

The units are designed for peak-load, emergency, or stand-by service. Included in the $100-per-kw selling price is plant equipment plus installation direction and labor.

Powered by an experience-proved 11,000-kw gas turbine, the package plant is a compact, self-contained generating station capable of operation in conjunction with other generating equipment or as an isolated and independent station. It can start without any external source of power and can be on the line at full load in less than 15 min. No external water is required for cooling, permitting maximum site flexibility. An optional dual-fuel (gas or distillate oil) system permits low operating costs. It can be changed under load or while shut down, to take advantage of the most economical fuel.

The package plant is a complete and integrated power station consisting of two basic self-housed units mounted on integral structural-steel bases plus accessories.

The 10 × 36-ft power unit contains the gas turbine, station controls, and mechanical and electrical auxiliaries. The 10 × 28-ft generator unit contains an open ventilated generator, reduction gear, exciter, and cooling-air system. The air-inlet ducts, exhaust stack, maintenance crane, and outdoor metal-clad switchgear make up the plant accessories. Both basic enclosures are insulated thermally and acoustically and include lighting, heating, and fire-protection equipment. A variety of inlet and exhaust arrangements are available. Silencers are included as standard equipment and inlet-air filters and/or coolers can be added when conditions require.

The standard crane supplied with the plant has sufficient lifting capacity to handle the heaviest components moved during maintenance and inspection. The unique enclosure design incorporating hinged side panels further simplifies maintenance work.

The station is basically designed for remote unattended operation but can also be run as a locally operated manually controlled installation. Complete control and indication functions are provided in the operator's area at the front of the power-unit housing. When desirable, this control compartment can be separated from the rest of the power unit. Control intelligence for remote stations can be transmitted to and from the station by direct line, carrier current, or microwave.

As an addition to the basic package, a step-up power transformer and associated outdoor station structure can be supplied to deliver the station output at any desired voltage.

South Carolina Electric and Gas Company has purchased four of the new package units for use in new installations at Beaufort and Charleston, S. C. The first two units are scheduled to go on the line in June, 1961, and the other two in mid-1963.

Nuclear Briefs

▶ Research Reactor Ready for Operation in Japan

THE JRR-2, the largest nuclear research reactor in the Far East, at Tokai-mura, some 70 miles from Tokyo, Japan, has been officially turned over to the Japan Atomic Energy Research Institute by American Machine and Foundry Company.

Designed and built by AMF for the Institute, Mitsubishi Atomic Power Industries was an important subcontractor for the $1.5-million reactor.

The JRR-2 reactor is an all-aluminum 10-mw heavy-water-moderated tank-type reactor. Light water and steel serve as a thermal shield instead of the customary graphite and lead, in order to reduce the possibility of radiation damage in the reactor.

The Japan Atomic Energy Research Institute employs nearly 1200 people at its headquarters in Tokyo and at Tokai-mura. Established in 1957, the Institute now has 40 buildings in which a wide range of research, testing, and experimentation is conducted in the nuclear field.

▶ Thermionic Converter for Nuclear Applications

A thermionic converter for direct conversion of electricity in conjunction with nuclear reactors is being developed by the Bendix Corporation.

The company's Red Bank, N. J., division has already developed a cesium-vapor thermionic converter that generates 5 watts of electricity directly from solar energy.

Electrical power is produced by the application of heat to a $^1/_4$-in-diam cathode used in conjunction with an anode. The use of cesium vapor permits the spacings between the cathode and anode to be 50 times greater than those of vacuum-type converters—a design that improves reliability and life expectancy, provides simpler manufacturing techniques, and greater resistance to shock and vibration.

▶ Cusped Magnetic Fields Used in Thermonuclear Research

A relatively new approach to the thermonuclear problem is reported in an article by F. L. Ribe of Los Alamos on "AEC-Sponsored Controlled Thermonuclear Research" in the British journal *Nuclear Engineering* for October, 1960. It involves injecting a dense stream of energetic plasma from a gun into a magnetic bottle in such a way as to "inflate" it.

In the entropy-trapping concept a fast jet of relatively cold plasma is projected axially into a "picket-fence" or cusped magnetic-field geometry. The plasma exerts a dynamic pressure on the magnetic field, and this is made great enough to force the magnetic lines apart, allowing the fast jet to enter the central region of the confinement geometry.

The action of forcing its way in, together with scattering of the beam off the inside magnetic walls, randomizes the individual particle motions so that, on turning the jet off, the inside plasma cannot exert enough pressure to force its way out and it is consequently trapped. This method, originated at Los Alamos, is being studied also at General Atomic Division of General Dynamics Corporation in San Diego, and at Lawrence Radiation Laboratory in Livermore, Calif.

Various types of plasma guns are used: A Los Alamos gun has achieved a stream of hydrogen plasma of some 5×10^{16} ions having an average energy of the order of 10 kev. In the General Atomic experiment the plasma is observed to open the input throat of the cusp and to be detained inside for about 40 microsec with a number density greater than 10^{15} particles per cu cm. In the Los Alamos experiment the plasma is observed to force a passage through the input of the cusp under certain conditions of density and velocity and to remain in the cusp for the order of 40 microsec. Theoretically, if the magnetic field at the input to the cusp is made sufficiently strong, its pressure should lead to the exclusion of the plasma stream. This effect has so far not been observed in the cusp experiments in spite of extensive work.

Thin-Wall Bend. Boeing in Wichita, Kan., has developed a technique for bending 8-in-diam thin-wall (.044-in.) drawn aluminum tube with a bend radius of 2.5 diam. It is done with a modification of a machine manufactured by Pines Engineering Company of Aurora, Ill., using a ball-jointed mandrel.

Generator Spider. This giant spider, weighing 32 tons, is for the first of two generators Allis-Chalmers will supply to add 47,368 kva to the capacity at Bull Shoals in Arkansas.

Lilliputian Grinding Wheel. Bay State Abrasive Products Co. of Westboro, Mass., makes what may be the world's smallest grinding wheels, to break one of the serious cost bottlenecks in the production of microminiature mechanisms. Critter on left is a fly, whose eye is just about the size of the grinding wheel.

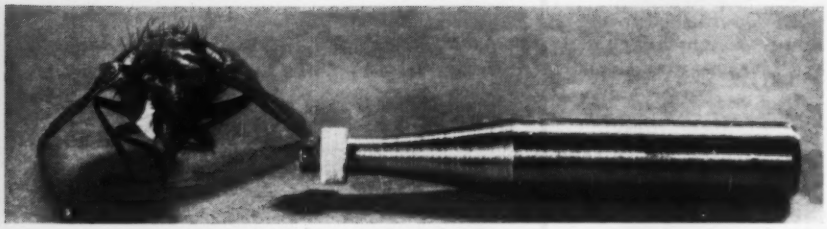


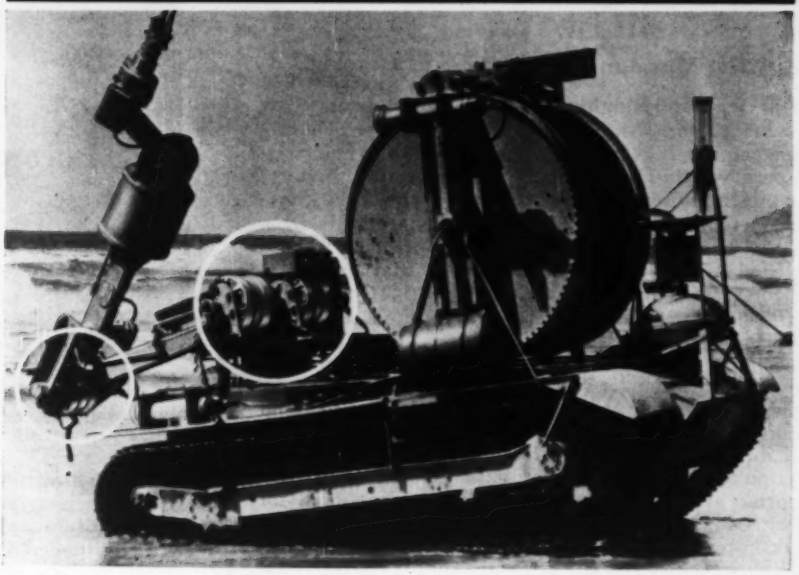
PHOTO BRIEFS

M. BARRANGON

Infrared Window. Hughes Aircraft cast this 15-in. germanium disk which is optically clear for infrared wave lengths. Purpose: Greater scope for infrared missile-detection sensors.

Photomultiplier Ion Gage. Developed by Westinghouse, this instrument measures extreme low pressure for an ultrahigh-vacuum research program on controlled nuclear fusion for peacetime uses.

Deep-Sea Vehicle. The Navy's deep-sea crawler (with television remote control) has a boom-mounted mechanical arm developed by a division of General Mills, Inc., Minneapolis, Minn. The electromechanical actuators were produced by the Ex-Cell-O Corp. at Greenville, Ohio. The arm, synthesizing motions of human arm and hand, is remotely controlled from shore.



Engineering Progress in the British Isles and Western Europe

J. FOSTER PETREE
European Correspondent

EUROPEAN SURVEY

Heat Pump in Power Stations

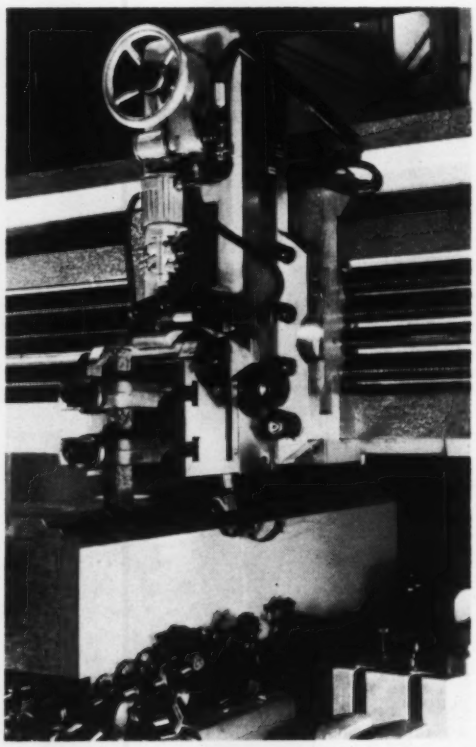
THE Central Electricity Generating Board, the agency responsible for electric power generation in England and Wales, has been studying the economics of the heat pump, examples of which have been at work for varying periods in four of its power stations. The study, which has extended over three years, has established that over-all seasonal performance energy ratios of between 5 and 6 may be obtained with heat pumps in power stations using cooling towers, with a representative mean seasonal low-grade heat source temperature of 73 F and an output temperature of 130 F. The corresponding value of the ratio for river-cooled stations approaches 3, with a source of temperature about 14 F less (that is, 59 F).

With a source temperature at or above 73 F, the heat pump has a direct advantage over direct steam heating; with a performance energy ratio of 5 it can provide a given amount of useful heat on half the fuel needed for direct steam heating.

Industrial Museum

THE city of Birmingham, England, where James Watt and his partner Matthew Boulton developed Watt's steam engines, is at last to have a scientific and industrial museum worthy of its place in engineering history. The present museum, housed in what used to be a silverware factory, more than 150 years old, dates only from 1951 as a museum. But in that short time it has gathered a notable collection of exhibits that range from ancient steam engines to the car in which John Cobb established the land speed record of 394 mph, as well as a working model of an atomic reactor. It is the only museum in the country where old steam engines are periodically run under steam. The buildings, however, are in a bad way, so the city council has decided to spend about $1,800,000 on rebuilding. The new buildings will include a Locomotive Hall, to house all forms of traction machinery, together with machine tools and scientific apparatus, and a main Engineering Hall for industrial exhibits and reconstructions of old handicraft workshops. It also will house a lecture hall and refreshment facilities. The first stage should be completed by 1964. The entire scheme should provide one of the finest industrial museums in Europe.

Correspondence with Mr. Petree should be addressed to 36 Mayfield Road, Sutton, Surrey, England.



Reversing toolholder for two-way cutting on heavy planing machine, also may cut on one stroke only

Two-Way Tool Box for Large Planer

WERKZEUGMASCHINENFABRIK Adolf Waldrich Coburg, of Coburg, Bavaria, Germany, makers of heavy machine tools, have developed a two-way toolholder for their planing machines, to enable cuts to be made at equal speeds in both directions. The tool is held in a cylindrical holder which rotates to bring it into position for the forward and return strokes. The tool carrier is swiveled by two racks under the control of a setting device and is operated by a pneumatic piston, actuated magnetically by the reversal of the table. The reversing action can be engaged or disengaged by means of a selector switch on the control panel, and it is possible also to cut on either the forward or the return stroke only.

Esso Refinery and Oil Terminal

At Milford Haven, in the southwest corner of Wales —a district often spoken of as "Little England beyond Wales"—the Esso Petroleum Company now has in operation a new refinery designed to process $4\frac{1}{2}$ million tons of crude oil a year as a start. It has a deepwater marine terminal that will accommodate two 100,000-ton tankers, as well as smaller vessels, at one time and at any state of the tide. It has taken only a few weeks over two years to build—construction began in July, 1958—and has cost approximately $50 million. The plant will produce gasoline, jet fuels, diesel fuels, gas oil, boiler fuel oils, propane and butane, which will be distributed throughout those parts of Great Britain lying west of a line from Inverness to Plymouth.

Esso already has one refinery in England, at Fawley, on Southampton Water. Originally designed, after the war, to handle 6 million tons a year, it is now processing more than 10 million; but at that it has about reached the limit for the site and it was necessary to look elsewhere for further capacity. In addition, water depth at Fawley is insufficient for the largest tankers now being built. This was the main factor in the choice of Milford Haven. The new terminal is T-shaped, with a pier 3500 ft long extending out from the shore and a pier-head wharf 2600 ft long at right angles to it, forming the top of the T. The whole jetty is of concrete, with the superstructure (largely precast) supported on prestressed hollow piles. The total length of piling is about 19 miles, the whole of which was cast on site. The piles were cast in lengths of 500 ft in five parallel beds and divided into the required lengths, the longest being 143 ft. The tankers lie against fenders having steel spring buffers that are designed to take the impact of a vessel of 135,000 tons coming against them at an angle of 10 deg and a speed of 1 knot. As the difference in level between a loaded tanker at low tide and an empty one at high tide can be as much as 78 ft, the two hose-handling towers had to meet both conditions; they are 128 ft high and are believed to be the largest at any oil port in the world. The discharge pipeline along the jetty is 36 in. bore.

On the refinery site of 350 acres there are 69 storage tanks of sizes up to 54 ft high and 150 ft diam, and four Horton spheres for storing liquefied petroleum gases under pressure. The total storage capacity is nearly 190 million Imperial gallons. The tanks are all-welded and many of them have floating roofs to minimize air pollution and evaporation losses. The pipestill furnace, one of the largest in the world, has 52 burners, using either gas or oil, and a heat output of 465 million Btu per hr. The tallest of the fractionating towers is 211 ft high and 9 ft diam. It was assembled and welded together on the ground. When completed, it was lifted to the vertical position, placed on its foundation, and bolted down in $2\frac{1}{2}$ hr. The plant is the first in the United Kingdom to be entirely cooled by air. Another feature is the use of a multijet ground flare for disposing of excess gases; the flare is not visible, and the combustion is highly efficient, which again reduces air pollution.

The pipestill furnace at the Esso refinery, Milford Haven, has a heat output of 465 million Btu per hr from 52 burners. It is one of the world's largest. At right is associated distillation column.

When construction work was at its peak, 3300 men were employed on the site. One tenth of that number serve to operate the refinery, thanks to an exceptionally high degree of automation. The whole plant is automatically controlled from one central control room, and in another room the liquid level and temperature in every tank are recorded electronically. The annual electricity consumption will be about 100 million kwhr, taken from the national grid, and about 360 million gallons of water will be used for steam-raising.

Checking steel plates for mill scale by the Shell copper-sulfate method at Cammell-Laird shipyards, Birkenhead

Detection of Mill Scale

A quick and inexpensive method of checking the completeness of removal of mill scale from steel plates has been evolved by the Research Center of the Shell Petroleum Company at Thornton, Cheshire, England, and is now in use in the fabricating shops at the shipyard of Cammell Laird & Co. Ltd., shipbuilders and engineers of Birkenhead. It is the practice to shot-blast the plates before fabricating, but this process admits of many variables. The speed of passing the plate through the blast, the thickness and hardness of the scale, and deterioration of the shot, all affect the result, and to an extent not accurately determinable by the eye. The Thornton method is to apply a solution of copper sulfate to the freshly shot-blasted surface. Areas entirely free from scale become coated with copper, but residual scale does not and shows up as a dark patch against the copper background. The copper sulfate is applied with a pad or sponge, and no other equipment is needed.

Substance in Brief of Papers Presented at ASME Meetings

ASME TECHNICAL DIGEST

Gas Turbine Power

Shock Losses in Transonic Compressor Blade Rows..60—WA-77... By Genevieve R. Miller, George W. Lewis, Jr., and Melvin J. Hartmann, Lewis Research Center, NASA, Cleveland, Ohio. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Engng. for Power;** available to Oct. 1, 1961).

Subsonic compressors were, for many years, limited to relative flow velocities equal to a Mach number of 0.75 or below. This limitation was a result of increasing losses, which occurred above this relative Mach number and, for the low energy additions utilized, caused a sizable loss in compressor efficiency. However, by the use of blade shapes less susceptible to shock losses, good compressor performance was obtained with a transonic compressor in which the tip relative flow velocity was slightly supersonic. The data from this early transonic compressor seemed to be a simple extension of that obtained from subsonic compressors. The loss data obtained from this transonic compressor rotor could be correlated with subsonic compressor losses by use of the loading parameter D factor. Because of this correlation, it was felt that the shock losses in this transonic compressor rotor were negligible. However, as more data became available over a wider range of loadings, Mach numbers, and solidity it was obvious that the D factor was not sufficient to establish design conditions of transonic compressors. A study was made of the blade element loss taken from 14 transonic compressor rotors to obtain a physical understanding of the nature of the shock losses, to correlate these losses, and to determine methods of predicting the losses in transonic blade rows. The approach is to review several studies of shock losses in transonic compressors and to compare the results of these studies with an analytical solution of the flow field. In addition, two experiments were conducted to obtain an understanding of the shock configurations in transonic blade rows. A hot-wire anemometer was utilized to determine the blade-to-blade loss distribution in a rotor with shock losses. High-frequency-response barium titanate crystals were used to indicate shock location in the blade passage. Finally, a method utilizing estimated shock losses for design of transonic blade rows is suggested by the analysis.

The MU-CYL-JET; The Multicylinder Turbojet Engine..60—WA-84... By R. W. Pinnes, Mem. ASME, Bureau of Naval Weapons, Department of the Navy, Washington, D. C. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Engng. for Power;** available to Oct. 1, 1961).

Recent developments in the small turbojet-engine field have again demonstrated the good specific-weight potential of the small engine. Naturally, this has generated interest in the use of these engines for applications of current interest. Unfortunately, most current thrust requirements are so great that a relatively large number of the small engines would be needed. These large numbers are undesirable from an installation and control standpoint. In an effort to obtain the good specific weight of the small engine, without the complexities of large numbers, the concept of "multicylinder turbojet engine" (MU-CYL-JET) has been developed.

This paper outlines the reasoning from which the concept evolved, describes the proposed engine configuration, and estimates the gain in engine specific weight which might possibly be obtained. In addition, the operating characteristics of a multicylinder engine are compared briefly with a single-barrel engine of the same thrust rating. The results of an independent feasibility study of the MU-CYL-JET concept, conducted by an engine contractor, are presented briefly. The study concludes that the concept is completely feasible.

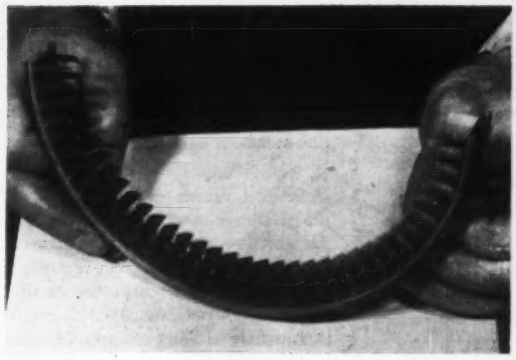
The J83 Seven-Stage Transonic Compressor..60—WA-93... By J. A. King, The Garrett Corporation, Los Angeles, Calif. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Engng. for Power;** available to Oct. 1, 1961).

During the early 1950's the NACA conducted a research program on transonic compressors, the high light of the program being the publication of references. During the early part of this program, the Fairchild Engine Division was awarded a contract to design and construct a small turbojet engine. At that time the future of the transonic compressor was beginning to look very promising, so a seven-stage transonic machine was selected as the compressor component for this engine, the J83.

The J83 turbojet engine was a high-performance, lightweight engine with a maximum thrust of 2450 lb, a diameter of 18 in., and a weight of approximately 300 lb. The compressor for this engine was a seven-stage, transonic, axial-flow compressor with an inlet tip diameter of 15.2 in. and a hub-tip ratio of 0.433. Details of the aerothermodynamic design of this compressor and the problems encountered during its development are given in this paper.

Résumé of Transonic-Compressor Research at NACA Lewis Laboratory..60—WA-97... By Seymour Lieblein and Irving A. Johnsen, Lewis Research Center, NASA, Cleveland, Ohio. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Engng. for Power;** available to Oct. 1, 1961).

During the past decade, the Lewis Laboratory of the NACA was engaged in intensive research on the aerodynamics of high-performance, axial-flow compressors. The focal point of this pro-



Typical T58 compressor blades, **above**, and fixed stator-vane ring, **left**. The rotor blades and variable vanes are fabricated by the pinch and roll process (60—WA-171).

gram, the development of the transonic compressor, is briefly reviewed, and the basic significance of the results is discussed. Following this, a résumé of succeeding experimental single and multistage investigations and analytical studies is given to indicate the scope of the work and the major results achieved. An extensive bibliography covering the research effort during this time is included.

This program has demonstrated that there is no Mach number "barrier" for axial-flow compressors, but rather that a continuous spectrum of performance exists as design Mach number is increased from subsonic values into the supersonic range. It has shown that, through the application of proper design concepts, high-pressure ratios and high mass-flow capability can be achieved with little, if any, penalty in efficiency.

Design and Development of a Transonic Compressor for General Electric's T58 Turboshaft Engine..60—WA-171... By Morris H. Thorson, General Electric Company, West Lynn, Mass. 1960 ASME Winter Annual Meeting paper (multilithographed; available to Oct. 1, 1961).

Transonic compressor work was started at NACA when the T58 compressor development was initiated.

The General Electric T58 engine is a high-performance, lightweight gas turbine engine in the 1000-HP class for use in aircraft (particularly helicopters), marine, and industrial applications. Its compressor is a ten-stage, axial-flow design, of medium (8.3:1) pressure ratio, utilizing front variable stators to obtain good part-speed stall margin. The early stages of this compressor are of the transonic type. The general layout of the engine includes an annular combustor, a two-stage gas-generator turbine, and a single-stage, "free" power turbine.

With the design data available, the author's company built an eight-stage transonic test compressor in the T58 size. However, this machine did not meet all the performance objectives and the decision was made to design the ten-stage compressor. The design was completed three weeks after the go ahead, was on test in an engine six months later and, in another seven months, had passed its official preliminary flight rating test.

A Practical Method of Predicting Transonic-Compressor Performance..60—WA-191... By W. C. Swan, Boeing Airplane Company, Renton, Wash. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Engng. for Power;** available to Oct. 1, 1961).

In the process of designing a modern jet-engine compressor it is not merely sufficient to obtain an adequate description of the flow process at design point, but a reliable means of estimating performance at flows and speed far from design is essential in order to match the engine components properly prior to the initial build. The pressing demand for lighter engine weights has made the available techniques of performance prediction of axial-flow compressors even more critical, particularly when compressibility effects and passage shocks occur. In general, these complex flow conditions have been resolved only through extensive development testing of single-stage designs before a reliable multistage compressor map could be defined. The purpose of this study was an attempt to develop a practical digital-computer program which could be used to describe rapidly the performance of high-performance single stages of arbitrary geometry at speeds and flows significantly removed from design, such that the stage characteristics could be presented and analyzed without the need for extensive testing.

A real fluid-stream filament axial-flow-compressor performance method is deduced from theory and statistics. The nonisentropic complete radial equilibrium-momentum equation is combined with the continuity, energy, and flow-process equations to yield a group of equations which is readily adaptable to solution on a digital computer. The real fluid effects, such as subsonic viscous losses and shocks at cascade entry, are deduced from statistics in terms of a blade-loading parameter. A program suitable for rapid calculations on a digital computer is presented in schematic form. A comparison between the deduced and the measured performances of an arbitrary stage is made. The correlation obtained indicates that the performance method is reliable.

Aerodynamic Design and Performance of Five-Stage Transonic Axial-Flow Compressor..60—WA-229... By Karl Kovach, General Electric Company, Cincinnati, Ohio; and D. M. Sandercock, Lewis Research Center, NASA, Cleveland, Ohio. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Engng. for Power;** available to Oct. 1, 1961).

The requirements of effective aircraft propulsion indicate the desirability of operating lightweight, compact turbojet engines that are highly efficient over wide ranges of operation. From the viewpoint of the compressor, reduction in the size and weight can be effected by reducing the number of stages required to produce the desired pressure ratio and decreasing the diameter by increasing the mass flow per unit frontal area. These requirements for higher levels of stage performance can be met theoretically by increasing the inlet Mach number relative to the rotor.

A five-stage axial-flow compressor with all rotors operating with transonic relative inlet Mach numbers was designed as a research vehicle at the Lewis Research Center in 1952. The compressor

was designed and tested as a component of a turbojet engine. This paper summarizes the research work done on this compressor including the aerodynamic design and detailed performance characteristics.

Metals Engineering

Experimental Investigation of Corners in the Yield Surface..60—WA-7... By Aris Phillips, Yale University, New Haven, Conn.; and G. A. Gray, Virginia Polytechnic Institute, Blacksburg, Va. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Basic Engng.;** available to Oct. 1, 1961).

The results of 14 combined stress tests with variable stress ratios on annealed commercially pure aluminum are reported. Thin-walled tubes of annealed commercially pure aluminum (2S-O) were subjected to various combinations of axial tension and torsion along nonradial paths of loading. The purpose of these tests was to investigate the changes in the yield surface during loading and the existence of pointed vertices in the yield surface. Hence the paths of loading were selected so that pointed vertices in the yield surface might appear if they existed.

The tests were made on a combined tension-torsion testing machine of a dead-load type. It is shown that the loading path carries a pointed vertex with it. However, the direction of the plastic-strain increment vector differs only slightly from the direction predicted by the Mises theory. Finally, the experiments indicate that the form of the yield surface at a considerable distance from the stress increment vector agrees much better with the prediction of the slip theory than it does with the prediction of the Mises theory.

Tensile Properties of AISI Types 304 and 347 Stainless Steels at Moderate Temperatures for Section Sizes Ranging From Bars to Extremely Large Forgings..60—WA-9... By W. H. Pryle and E. T. Wessel, Westinghouse Research Laboratories, Pittsburgh, Pa. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Basic Engng.;** available to Oct. 1, 1961).

In recent years many new applications have been found for austenitic stainless steels; in particular, in the nuclear-reactor field. Current design trends make it imperative to have precise data on mechanical properties, primarily yield strength.

The tensile properties of AISI types 304 and 347 annealed stainless steels were investigated for the temperature range from 75 to 800 F. Several lots of materials were studied in each of several section sizes ranging from bar stock to extremely large forgings. A considerable variation in properties, particularly yield strength and elongation, were observed between different lots of a given type of steel of a given size category. These variations correlated with variations in the annealed hardness and are attributed to the use of different annealing treatments by the suppliers.

At equivalent hardness levels the properties obtained from the various section sizes were comparable. Within any given lot or forging the properties were quite uniform for equivalent specimen orientations. The transverse ductility of the large forgings was considerably less than the longitudinal ductility. However, this relatively poor ductility did not lead to notch sensitivity or embrittlement problems.

Short-Time Tensile Properties of Type 316 Stainless Steel at Very High Temperatures..60—WA-11... By T. W. Gibbs and H. W. Wyatt, Mem. ASME, Avco Corporation, Wilmington, Mass. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Basic Engng.;** available to Oct. 1, 1961).

Superalloys and refractory metals are usually considered for severe high-temperature service. The disadvantages include high cost, lack of availability, and the difficulty of fabrication. Also, many of the superalloys suffer drastic loss of strength beyond their intended temperature range of application because of deteriorating solid-state reactions such as overaging and corrosion.

The somewhat unique short-time temperature histories in missile design allow for the consideration of materials originally not intended for very high-temperature service. Examples of these are the austenitic stainless steels. These alloys, such as AISI Type 316 were originally developed because of their excellent corrosion resistance and creep resistance at elevated temperatures.

An evaluation program was conducted on Type 316 stainless-steel sheet material to determine the effects of residual cold-work and welding on the room-temperature and elevated-temperature mechanical properties to 1800 deg F. Short-time tensile and tensile-creep elongations tests were run to determine the stresses required to produce elongations up to 10 per cent in 2 min. The effect of welds in tension was to lower the elongation with no loss in strength. The effect of cold-work on the annealed material was to increase appreciably the strength properties, thus allowing for higher design stresses. The results of a few tests indicate that Type 316 stainless steel retains some strength properties up to 2300 deg F. A definite stress-strain relationship exists in which the 0.2 per cent yield stress is very close to the tensile stress.

Bursting of Tubular Specimens by Gaseous Detonation..60—WA-12... By P. N. Randall and I. Ginsburgh, Standard Oil Company (Indiana), Whiting, Ind. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Basic Engng.;** available to Oct. 1, 1961).

Several recent occurrences in oil refineries have revealed an unusual mode of failure for pipe and pressure vessels, namely, bursting by the detonation of their gaseous contents. From the technical literature, it is known that the magnitude of the pressure pulse imposed momentarily by a detonation is very much higher than the pressure caused by slow combustion. It also is known that the front of the detonation wave is a pressure discontinuity and that the detonation travels at a velocity of thousands of feet per second. Thus a detonation imposes a shock load on the pipe wall as it traverses the pipe.

The authors describe some experimental work designed to investigate the bursting of pipe and pressure vessels by gaseous detonation. The test specimens were 3.25-in-OD tubes, 12 in. long, and of 0.040 to 0.070-in. wall thickness. The specimens, cut from hot-rolled carbon-steel pipe, and also from drawn carbon-steel tubing, were tested at several temperatures, which were chosen to produce failures both above and below the brittle transition temperatures for the two materials. In addition, an austenitic-stainless-steel specimen was tested under very severe conditions in several unsuccessful attempts to fragment it.

The results were reassuring in that the strength exhibited by the specimens was surprisingly high, even for those which failed in a brittle manner. Their brittleness at the lower temperatures appeared to be simply another manifestation of the transition temperature phenomenon.

Effect of Cell Geometry on the Shear Modulus and on Density of Sandwich Panel Cores..60—WA-52... By Chieh C. Chang and Ibrahim K. Ebcioglu, University of Minnesota, Minneapolis, Minn. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Basic Engng.;** available to Oct. 1, 1961).

One of the principal elements in sandwich structure is the core. For bending, it transmits the shear between the tension stress of one face to the compression stress of the other. It carries the transverse compression resulting from loading normal to the panel. It is, therefore, very essential to the sandwich structure. For efficient sandwich structure, the

core must be lightweight and strong in carrying the loadings, particularly transverse shear.

A simple analytic theory for the effect of cell geometry on both the shear modulus and the density of sandwich panel core is presented. The core shear modulus in different directions is analyzed to include the effects of the bond weight parameter $(\rho_b/\rho_f)(t_b/t)$, the angle α, and the aspect ratio b/a of the cell. It is also found that the minimum cell weight of the sandwich core depends both on the cell angle α and the cell aspect ratio b/a. The theory compares fairly well with some available experiments. The cell geometry chosen is so general that the regular hexagonal and square cells of commercial sandwich cores are special cases.

The Fabrication of Thin-Wall Molybdenum Shapes by Welding..60—WA-53... By W. F. Brown and M. A. Pugacz, General Electric Company, Cincinnati, Ohio. 1960 ASME Winter Annual Meeting paper (multilithographed; available to Oct. 1, 1961).

A welding fabrication procedure is described that is suitable for the production of thin-walled molybdenum components such as tubes, crucibles, furnace liners, high frequency furnace susceptors, and heat exchangers. A detailed procedure for the fabrication of a thin-walled tube is given. Sheet material 0.015 in. thick was used, and welding was done in air using the automatic inert-gas tungsten metal-arc process. The results indicate that thin molybdenum sheet material can be welded in air with the resulting joints exhibiting sufficient ductility to permit fabrication and use when precautions are exercised in all phases of fabrication and assembly.

Effect of Combined Stress on Yield and Fracture Behavior of Zircaloy-2..60—WA-96... By R. L. Mehan, General Electric Company, Schenectady, N. Y. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Basic Engng.**; available to Oct. 1, 1961).

The yielding and fracture characteristics of Zircaloy-2 as a function of stress state were investigated at room temperature through the medium of thin-walled cylindrical specimens under internal pressure and axial tension. Stress states from uniaxial longitudinal tension to uniaxial tangential tension were examined. Two tests at elevated temperature were performed at a single stress ratio.

It was found that the fracture ductility lessened with increasing biaxiality. A minimum in ductility was found at balanced biaxial tension where the fracture ductility, as expressed by the effective strain, was 29 per cent. The yielding and plastic flow properties were found to be highly anisotropic. Two methods were used to express the plastic flow data: a graphical approach and a theoretical analysis based on a theory proposed by R. Hill, either one of which is suitable to express the flow properties of Zircaloy-2 under various states of combined stress.

Empirical Correlation of Maximum Load Data From Published Brittle and Ductile Fracture Tests of Centrally Slotted and Centrally Loaded Plates and Sheets..60—WA-135... By A. G. Holms, Mem. ASME, Lewis Research Center, NASA, Cleveland, Ohio. 1960 ASME Winter Annual Meeting paper (multilithographed; available to Oct. 1, 1961).

A procedure is given for correlating maximum load data from tests of centrally slotted wide plates and sheets loaded to fracture in static tension. The procedure uses an elementary function of the initial specimen dimensions and the method of least squares to evaluate three empirical constants from a series of tests of specimens with the following conditions constant: (*a*) Material composition, (*b*) metallurgical processing, (*c*) thickness, (*d*) notch radius at ends of slot, (*e*) temperature. The procedure accounts for variations of plate width and crack length.

The validity of the procedure was verified by checking it against published data where the properties of the materials varied widely including steels that fractured entirely by cleavage at low temperatures, steels that changed fracture mode with specimen dimensions, and steel and aluminum alloys that fractured entirely in shear.

Application of a Cumulative Damage Concept to Fatigue..60—WA-144... By R. R. Gatts, Assoc. Mem. ASME, General Electric Company, Schenectady, N. Y. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Basic Engng.**; available to Oct. 1, 1961).

The distinguishing feature of fatigue is the cyclic nature of the load, often expressible in terms of a stress amplitude. The outstanding characteristic of the effect of cyclic loading is the cumulative nature of the resulting damage. No one cycle is completely responsible for the total damaging effect but rather many cycles each make a small contribution.

A general concept of the accumulation of damage is described. This concept is combined with a particular hypothesis for the accumulation of fatigue damage. Initial and failure conditions are established for use with the equation, and the solution for constant stress amplitude is discussed. Simple algebraic expressions are developed in terms of the nominal stresses and cycles commonly associated with machine design and stress analysis. These expressions are compared with data from rotating bending tests of steel specimens and found to be in good agreement. Nondimensional co-ordinates are used to provide a composite plot of S-N data from a wide range of steels.

Power

A Simplified Analysis of the No-Load Stability of Mechanical-Hydraulic Speed Control Systems for Steam Turbines..60—WA-34... By M. A. Eggenberger, Mem. ASME, General Electric Company, Schenectady, N. Y. 1960 ASME Winter Annual Meeting paper (multilithographed, available to Oct. 1, 1961).

When parameters of a steam turbine speed-control system for a new unit are substantially different from past successful practice, it is necessary to evaluate the changes and their influence on the stability of the control system. In particular, it is advisable to analyze the no-load stability at synchronizing speed in order to make sure that the unit can easily be synchronized without the annoyance of hunting.

The subsequently described method for such a no-load stability analysis has been developed in order to make it possible to evaluate a set of given parameters with a minimum of work and, if necessary, to decide quickly what modifications must be made in order to obtain an acceptable system.

The presented method is based on the Bode frequency-response theorem and is using exclusively linearized equations whereby effects such as inertia of control components, compressibility, nonlinear flow characteristics, and similar effects have been neglected. However, this simplified method promises to be adequate for the intended purpose if a reasonably large phase margin is used.

Optimizing a Regenerative Steam-Turbine Cycle..60—WA-179... By G. Chiantore, D. Borgese, and F. Baldo, Edisonvolta, S.p.A., Milan, Italy; and J. H. Potter, Mem. ASME, Gibbs and Hill, Inc., New York, N. Y. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Engng. for Power**; available to Oct. 1, 1961).

The selection of the best steam-turbine regenerative cycle for a new power installation is normally determined by heat-balance studies of several alternative arrangements. The complexity of modern steam power cycles is reflected in the heat balances, and a great amount of time must be spent in the conventional heat-balance comparisons of the alter-

natives. As a result, many efforts have been made to set up rapid or shortcut methods for arriving at the optimum cycle.

The authors report on an analytical design method developed at the Edisonvolta, S.p.A., Milan, Italy, in which a minimum number of heat balances is required for the optimization of the feedwater-heater system. The method involves the analysis of a "basic" cycle, decided upon by the utility management and the manufacturer, as being appropriate for the installation.

Detailed calculations have been omitted. Superficially, the Edisonvolta approach appears complicated. However, an extremely logical and systematic method has been presented for analyzing the effects of even the small changes in the regenerative steam-turbine cycle. Italian experience has verified by comparison with traditional heat-balance procedure the usefulness and accuracy of the method, which has been used to optimize, among others, the cycle of the new Edisonvolta installation at La Spezia, Italy.

Ventilation of Eddystone Station—An Approach to Ventilation of Modern Steam-Electric Generating Stations..60—WA-44... By S. J. Kowalski, Mem. ASME, Philadelphia Electric Company, Philadelphia, Pa. 1960 ASME Winter Annual Meeting paper (multilithographed; available to Oct. 1, 1961).

Eddystone Station, with its large coal-fired steam generators, turbine-generator units, maze of steam pipes, large number of feedwater heaters, various large motors and hot ducts, emphasizes the problem of heat relief in steam-electric generating stations. The sources of heat are many, are widely distributed, and if not controlled will provide an extremely hot plant in which the operating and maintenance funtions become generally difficult and, in localized plant areas, may become impossible.

Three methods can be employed either singly or in combination to provide comfortable temperatures. They are (*a*) general plant ventilation; (*b*) spot ventilation at selected work areas; (*c*) removal of heat at the source to prevent its entry into the plant. An analysis of the design considerations of Eddystone Station illustrate how these three approaches can be used and further provide design criteria for determining the amount of ventilation required for steam-electric generating stations.

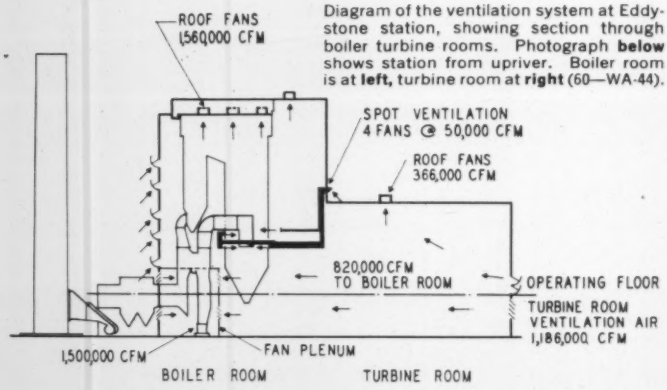
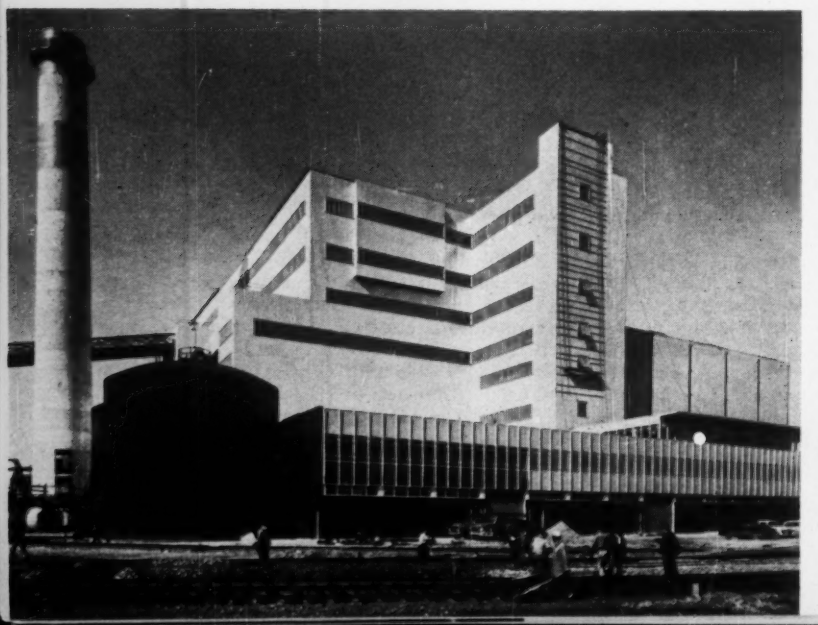


Diagram of the ventilation system at Eddystone station, showing section through boiler turbine rooms. Photograph **below** shows station from upriver. Boiler room is at **left,** turbine room at **right** (60—WA-44).



Methods of Obtaining Accurate Boiler Water Level Indication..60—WA-74... By James W. Williams, Yarnall-Waring Company, Philadelphia, Pa. 1960 ASME Winter Annual Meeting paper (multilithographed; available to Oct. 1, 1961).

The discrepancy between the water level in the gage glass and actual water level in the drum of a modern high-pressure steam generator has been well recognized. With the use of higher and higher boiler pressures these differences have become matters of great concern.

The problem of obtaining accurate drum-level indication is discussed. The need to consider the difference between the water level in the gage glass and the water level in the drum is presented and various methods of correcting for this difference are described. With increasing boiler pressures the intensity of the problem requires the use of instruments to replace the gage glass and to compensate for the water-level variation due to differences in density of the hot water in the drum and the water in the gage. Various methods of accomplishing this are discussed, including a remote water-level-indicator compensation system responding to both temperature and pressure variations as a basis for density correction. The effect of sudden and appreciable pressure drops on the reference level in the condensing chamber is also described and the remote water-level indicator readings which result are reviewed.

Economy of Efficient Air Preheating With Extraction Steam..60—WA-94... By M. K. Drewry, Fellow ASME, Wisconsin Electric Power Company, Milwaukee, Wis. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Engng. for Power;** available to Oct. 1, 1961).

Two per cent heat-rate improvement of a 275,000 kw unit results from efficient 2-stage steam air preheaters heating to 190 F with 5 F terminal temperature differences. Condenser heat rejection and turbine leaving losses are reduced substantially. Flue-gas losses are not increased. Air heater cleanliness is improved. Maintenance is reduced. Annual coal savings after fixed charges are one half of the net added investment.

To illustrate these several points in order that a conception may be obtained of their quantitative influences, studies applied to a recently installed 275,000 kw unit, Wisconsin Electric Power Company's Oak Creek Unit 5, are cited.

Test Boiler Facility—For Testing the Main Propulsion Machinery and Auxiliary Equipment of Nuclear-Powered Ships and Submarines..60—WA-146... By Forest J. Myers, Assoc. Mem. ASME, Newport News Shipbuliding and Dry Dock Company, Newport News, Va. 1960 ASME Winter Annual Meeting paper (multilithographed; available to Oct. 1, 1961).

In late 1957 the management authorized the construction of a steam plant capable of producing adequate high-pressure steam for the pierside operation and testing of the main propulsion machinery and auxiliaries of the atomic-powered aircraft carrier *Enterprise*. In addition, the steam plant was to be capable of receiving and condensing the entire steam output of one aircraft carrier reactor operating at maximum power conditions.

The unusual problems encountered during the planning and installation of the boiler, the rigid demineralized boiler-water requirements, and the unorthodox manner of operation of the boiler are described.

Vessel Machinery Performance Since World War II..60—WA-132... By Earl S. Shulters and F. H. Van Riper, Mems. ASME, Office of Ship Construction, U. S. Department of Commerce, Washington, D. C. 1960 ASME Winter Annual Meeting paper (multilithographed; available to Oct. 1, 1961).

Continuing economic pressures on ship operators, which have increased greatly since World War II, have resulted in a merchant marine with a "new look," representing an attempt to meet higher construction and operating costs with more efficient equipment and shorter turn-around time for the ships. These new devices almost without exception have been aimed at the human beings who man the ships at sea or work them in port. Primary emphasis has been in labor-saving, mechanically operated equipment, in place of manual control or handling. The general intent has been to relieve humans of heavy physical labor and give them "supervisory" control of an operation instead.

In many cases, the progress has been relatively painless, and the development has taken place without difficulties; in others, the advantages of the improvement have been in part offset by maintenance and repair costs, or downtime, or both, requiring modification or redesign to better meet the ship's needs. It is to these latter categories that this paper is devoted.

Evaluation of experimental installations and unique equipment from the standpoint of the problems encountered are discussed. The differences existing between shore and shipboard installations and design, along with the continuing needs arising out of the nation's requirements for a modern, competitive, and adequate merchant marine, are shown.

Transient Loading Improvements for Large Steam-Electric Generating Units..60—WA-51... By Charles Strohmeyer, Jr., Gilbert Associates, Inc., Reading, Pa. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Engng. for Power;** available to Oct. 1, 1961).

The author discusses the ultimate in operating flexibility during transient conditions that can be built into new designs having steam conditions of 2400 psig, 1050/1000 F reheat or above. The following discussion proposes an over-all operating philosophy in the hope of developing better understanding among the engineers, operators, and equipment manufacturers.

Emphasis is placed upon steam temperature control to suit various turbine operating conditions. New methods proposed include a means of raising throttle steam enthalpy during hot turbine starts, a control and supervisory system for regulating unit start-ups and shutdowns, and a new means of cooling the low pressure turbine exhaust during start-up. As a result, for short-duration turbine-generator shutdowns of 8 hours, units may be unloaded rapidly at full pressure and in some cases may be restarted from turning gear to one-third load restoring design primary steam temperature and pressure in as little as 35 minutes without sacrifice of safety.

Methods for Measuring Steam Turbine-Generator Performance..60—WA-139... By K. C. Cotton and J. C. Westcott, Mems. ASME, General Electric Company, Schenectady, N. Y. 1960 ASME Winter Annual Meeting paper (multilithographed; available to Oct. 1, 1961).

The most accurate method of establishing the performance level of steam turbine-generators is to conduct tests according to the ASME Power Test Code. The accurate instrumentation and procedures required for acceptance tests are quite thoroughly covered in the Code. This paper describes simplified, but less accurate, methods of obtaining steam-turbine performance, some instrumentation techniques applicable to all methods of performance testing, and methods of checking the accuracy of acceptance tests.

It is concluded that turbine performance can be determined with a minimum of instrumentation from enthalpy-drop efficiency tests. If the turbine section normally operates in the superheated-steam region, these tests can be made accurately. Further investigations are required to evaluate the merits of this method for determining used energy end point of the reheat turbine.

Petroleum

You, Too, Can Be a Creative Engineer..60—Pet-8... By C. R. Hocott, Humble Oil and Refining Company, Houston, Texas. 1960 ASME Petroleum Mechanical Engineering Conference paper (multilithographed, available to July 1, 1961).

The author discusses briefly the more obvious aspects of creativity and the creative process, hoping thereby to remove much of the deterrent to creative action and to promote practices that will enhance its effective attainment. A short bibliography is presented at the end of the paper to benefit those interested in further study of the subject.

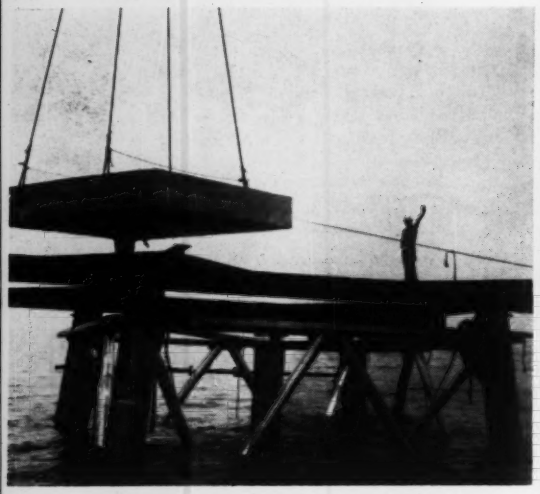
Graphical Solutions to Some Statistical Distributions..60—Pet-9... By Charles F. Lewis, Cook Heat Treating Company of Texas, Houston, Texas. 1960 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1961).

"All empirical data are probable only." Many engineers, particularly those who have been out of school for some time, are at a complete loss when confronted with problems of a statistical nature. They have not accustomed themselves to think in terms of the probability of an engineering occurrence. Though they will readily agree that such philosophy is the backbone of the entire insurance industry, these same men somehow fail to appreciate that the very same mathematical basis can be applied to such things as machine life, wear and fatigue problems, or a determination of the strength of materials. Flood-control design; the design wave in marine engineering; acceleration stresses by wind gusts on an airplane in flight, or in structural design; machine capability; the control of the quality of a manufactured product; management decisions in the face of uncertainty; inventory control—all of these are susceptible to a statistical approach.

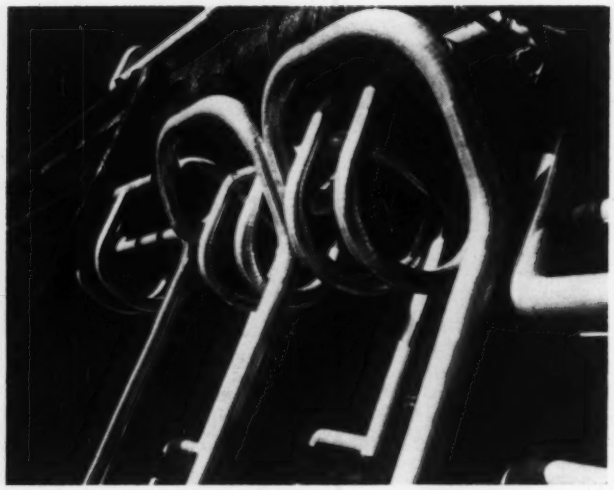
The techniques of probability plotting as applied to engineering problems are presented.

The normal, Weibull, and Gumbel distributions are discussed.

Preparation of the data, interpretation, and estimation of the distribution parameters are shown in detail by the use of examples.



A significant development in the structural use of aluminum is the aluminum-template offshore drilling platform (60—WA-13)



Aluminum jacketing over insulation retains a bright appearance. This is one of aluminum's major uses in petroleum processing. The metal is being used throughout the industry (60—WA-13).

Thin-Wall Pipe for Oil and Gas Lines..60—Pet-18...By W. P. Heineman, United Gas Pipe Line Company, Shreveport, La. 1960 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1961).

Recent interest in thin-wall pipe has been motivated primarily by economics, and the obvious savings in dollars requires no special analysis. The engineer, however, needs to be convinced that he is using a product capable of withstanding all the future loading conditions that may be imposed upon it. The successful operation of thousands of miles of large-diameter pipelines since World War II has also stimulated the trend toward thinner walls in the smaller diameters.

Stress levels in standard wall-thickness, small-diameter pipe are considerably lower than those in the larger diameter trunklines when operating at the same internal pressure. Where thinner wall pipe can be substituted for standard wall the savings are large. External coatings and cathodic protection are necessary when using lighter pipe and long life is desired. The thinner sections should not be of serious concern from a collapse standpoint since resistance to collapse is adequate. However, a defect in a thin wall can be more hazardous than in heavier wall, thus requiring more care in construction handling. Advantage should be taken of the high-yield-strength materials at medium and high-pressure service providing higher safety factors.

Since practically all thin-wall pipe is made by the electric-resistance-weld method, the purchaser needs to select his manufacturer, based on the quality of product beyond specification requirements. Pipe should be mill-tested and field-tested to the maximum pressures practical. Welding and bending require special consideration in the construction of thin-wall pipelines. However, these two problems are easily solved with experienced personnel and proper equipment.

Aluminum Applications in the Petroleum Industry..60—Pet-13...By Paul E. Brandt and R. W. Flournoy, Reynolds Metals Company, Richmond, Va. 1960 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1961).

During the past few years, the number of aluminum applications in the oil industry has increased greatly. The authors illustrate how these applications are justified on the strength of one or more of the aluminum economic advantages. Included are discussions of aluminum in drilling rigs, and offshore platforms, in oil country pipe and well-logging operations, and many other applications. Indicative of its advantages in many areas is the enumeration of its special advantages in pipelines, which are:

1 Lower handling costs because of light weight.

2 Faster welding during installation.

3 Painting and other protective maintenance eliminated in open installations.

4 Reduced suspension costs in overhead systems.

5 Reduced pumping costs or increased flow rates because of the lower coefficient of friction of aluminum, especially lower than that in old steel pipe.

6 Elimination of pipe wrapping in many soils.

7 Elimination of pipe cleaning when wrapping is required.

The prospect is for accelerated growth in aluminum applications.

Use of Copper Alloy Tubes in the Petroleum Industry..60—Pet-30...By Edward J. Duffy, Scovill Manufacturing Company, Waterbury, Conn. 1960 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1961).

Copper and copper alloys have inherently good resistance to corrosion by virtue of the property of forming films of insoluble products in many environments so that effective protection of the metal results. The authors discuss the effect of general classes of corrosive agents in relation to standard copper-base alloys. Emphasis is placed on the role of these alloys in the petroleum industry.

The effect of temperature is briefly discussed. The safe maximum temperatures recommended for common copper-base alloy tubes are presented. These temperature limits are based on the assumption that corrosion is nonexistent. Where corrosion does occur, the lowest possible temperature commensurate with the particular process is necessary as temperature effects accelerate corrosion rates in a very marked degree.

Hydraulics

Dissimilarity Laws in Centrifugal Pumps and Blowers..60—WA-145...By A. J. Stepanoff and H. A. Stahl, Mems. ASME, Ingersoll-Rand Company, Phillipsburg, N. J. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Basic Engng.**; available to Oct. 1, 1961).

Two kinds of dissimilarities are discussed: (*a*) Planned dissimilarities between the different hydraulic types as expressed by the performance specific speed; (*b*) deviation from geometrical similarity which is "forced" to accommodate some special condition at the same performance specific speed.

Experience has shown that, irrespective of a continuous variation of the design element of a consistent row of hydraulic types of impellers, there are certain factors or criteria which remain constant for different specific speeds. The best known of these is the suction specific speed. From the second group of dissimilarities the most common examples are mismatched impellers and cases. In solving such problems the designer's judgment is based on a knowledge of causes and effects in selecting certain design elements to meet the desired performance, because these follow certain rules which are "laws" of Nature. The object of this paper is to review the most common of these laws as applied to dissimilar pumps and blowers.

Theory of Scale Effects on Cavitation Inception on Axially Symmetric Bodies..60—WA-136...By R. Oshima, Hitachi Works, Limited, Hitachi City, Japan. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Basic Engng.**; available to Oct. 1, 1961).

On the assumption that the motion of incipient cavitation bubbles on geometrically similar bodies is dynamically similar, the relation between incipient cavitation number k_{di} and Reynolds number Re has been obtained from the dynamical similarity law deduced from the equation of the motion of spherical bubbles. A comparison of calculated values based on this theory with experimental data obtained by R. W. Kermeen and others shows good agreement at values of Reynolds number greater than the critical Reynolds number. Also, by comparing this theory with the formula by R. T. Knapp, concerning scale effects on cavitation inception, it is shown that Knapp's formula is a special case of the present theory.

Scale Effects on Cavitation..60—WA-151...By J. William Holl, Assoc. Mem. ASME, University of Nebraska, Lincoln, Nebraska; and George F. Wislicenus, Mem. ASME, Pennsylvania State University, University Park, Pa. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Basic Engng.**; available to Oct. 1, 1961).

Scale effects on cavitation are defined here as departures from the classical similarity relations when changing size, velocity, and/or properties of the fluid. The various phenomena governing such scale effects are examined and the resulting similarity laws, together with some expected scale effects, are tabulated. The theoretical expectations are then compared with extensive test data on desinent cavitation in cold water. This comparison leads to two different sets of plausible relationships for cavitation attached to a streamlined body, and cavitation not attached to a solid wall. However, the conclusions drawn are only tentative and qualitative, clearly indicating the need of further careful experimentation and analysis.

Particle Trajectories in a Gas Centrifuge..60—WA-158...By A. R. Kriebel, Stanford Research Institute, Menlo Park, Calif. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Basic Engng.**; available to Oct. 1, 1961).

The motion of spherical particles injected into a cylinder of gas which rotates as a solid body has been studied. The particle trajectory is expressed explicitly as a function of two dimensionless parameters: an injection-velocity parameter and an inertial parameter which is roughly the ratio of centrifugal force to drag force on the particle. The main results are the dependence on particle size of the time for particles to be centrifuged and of deposition angle. These results indicate performance limitations for an idealized cyclone separator and a centrifugal particle-size analyzer.

Experimental data are presented for an air centrifuge designed to approximate the analytical flow model. Reasonably good agreement with theoretically predicted deposition angles was found for spherical glass beads and irregularly shaped chalk crystals, even to Reynolds numbers in excess of the Stokes flow regime for which the analysis applies. Particles as small as 2 microns may be classified with the present centrifuge configuration; however, by modification it might be used to classify particles in the submicron-size range.

Inlet and Exit-Header Shapes for Uniform Flow Through a Resistance Parallel to the Main Stream..60—WA-160...By Morris Perlmutter, Lewis Research Center, NASA, Cleveland, Ohio. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Basic Engng.**; available to Oct. 1, 1961).

There has been a great interest in the flow of fluids through resistances parallel to the main fluid stream. There are many applications of this type of flow in such equipment as air driers and heat exchangers. The advantage of this flow geometry as compared with the case where the resistance is normal to the main stream is that a larger sized resistance can be used giving a lower total-pressure drop for the same mass flow and frontal area, or, if the flow-resistance size is constant, smaller frontal area and less fluid holdup in the system are obtained. The fluid holdup refers to the amount of fluid in the line during steady running conditions.

A disadvantage commonly found in this type of folded-flow system is that the fluid does not pass through the resistance uniformly. In many applications uniform flow through the resistance is desirable primarily because full use can then be made of the active surfaces of the equipment, and usually the total-pressure drop through the system will be less.

An analytical and experimental study of flow in headers with a resistance parallel to the turbulent and incompressible main stream has been made. The purpose was to shape the inlet and exit headers, which had a large length-to-height ratio, so that the fluid would pass through the resistance uniformly. Analytical wall shapes and estimated total pressure drop through the headers were compared with experimental results. Good agreement between analysis and experiment was found for the cases compared.

The Influence of Tip Clearance on Stall Limits of a Rectilinear Cascade of Compressor Blades..60—WA-163...By Ghassan Khabbaz and Yasutoshi Senoo, Massachusetts Institute of Technology, Cambridge, Mass. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Basic Engng.**; available to Oct. 1, 1961).

An experimental study of the influence of tip clearance on the stall limits of compressor blades was conducted on a rectilinear cascade. By using the mirror-and-image technique, the end-wall boundary layer near the clearance was dispensed with. The blade loading was maximum at a distance from the tip clearance, but the clearance was found to relieve the pressure gradient in general and to retard stalling.

The Jet-Flap Compressor Cascade..60—WA-165...By Eric F. Brocher, Therm, Inc., Ithaca, N. Y. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Basic Engng.**; available to Oct. 1, 1961).

Scholz's method for measurements on a two-dimensional cascade is extended to include mass and energy input into the main flow by trailing-edge jets.

Pressure recovery and mixing losses downstream of the cascade have been theoretically investigated and the need of low jet velocities has been emphasized. Improvements which can be expected by increasing the jet width but keeping the jet coefficient constant have been demonstrated.

The airfoil tested was the NACA 65-(12)10 compressor blade with a thickened trailing edge. A stagger angle of 45 deg and a solidity of 0.915 were used throughout. Results are given in the form of wake profiles, axial and tangential force coefficients, and cascade polars.

Heat Transfer

Heat Transfer to Longitudinal Laminar Flow Between Cylinders..60—WA-40... By E. M. Sparrow, Assoc. Mem. ASME, University of Minnesota, Minneapolis, Minn.; A. L. Loeffler, Jr., Grumman Aircraft Engineering Corp., Bethpage, N. Y.; and H. A. Hubbard, Lewis Research Center, NASA, Cleveland, Ohio. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Heat Transfer;** available to Oct. 1, 1961).

Consideration is given to the fully developed heat-transfer characteristics for longitudinal laminar flow between cylinders arranged in an equilateral triangular array. The analysis is carried out for the condition of uniform heat transfer per unit length. Solutions are obtained for the temperature distribution and, from these, Nusselt numbers are derived for a wide range of spacing-to-diameter ratios. It is found that as the spacing ratio increases, so also does the wall-to-bulk temperature difference for a fixed heat transfer per unit length. Corresponding to a uniform surface temperature around the circumference of a cylinder, the circumferential variation of the local heat flux is computed. For spacing ratios of 1.5 $\sim$ 2.0 and greater, uniform peripheral wall temperature and uniform peripheral heat flux are simultaneously achieved. A simplified analysis that neglects circumferential variations is also carried out, and the results are compared with those from the more exact formulation.

Radiant Interchange Between Circular Disks Having Arbitrarily Different Temperatures..60—WA-75... By E. M. Sparrow, Assoc. Mem. ASME, University of Minnesota, Minneapolis, Minn.; and J. L. Gregg, Assoc. Mem. ASME, Lewis Research Center, NASA, Cleveland, Ohio. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J Heat Transfer;** available to Oct. 1, 1961)..

The problem of radiant heat transfer between parallel disks has been analyzed by generalizing the standard gray-body enclosure theory. In particular, the assumption that the radiant flux leaving a surface and the local heat flux are uniformly distributed over the surface has been lifted by an integral equation formulation. It has been shown that the general problem of disks at arbitrarily different temperatures can be conveniently broken down into two subproblems, each of which can be solved independently of the temperature level. Numerical solutions of the governing integral equations have been carried out for spacing ratios b/R (b = spacing, R = disk radius) ranging from 5.0 to 0.05 and for emissivities ranging from 0.1 to 0.9.

Local heat-transfer results have been presented which, depending on spacing and emissivity, display marked variations over the disk surface. Over-all heat-transfer results have been calculated and compared with the predictions of the standard simplified enclosure theory. These predictions of the simplified theory were found to be unexpectedly good, especially in view of the large surface variations of the local heat transfer.

Investigation of the Nonisothermal Friction Factor in the Turbulent Flow of Liquids..60—WA-82... By D. A. Wiederecht, Assoc. Mem. ASME, Westinghouse Electric Corp., Bettis Atomic Power Laboratory, Pittsburgh, Pa.; and G. Sonnemann, Mem. ASME, University of Pittsburgh, Pittsburgh, Pa. 1960 ASME Winter Annual Meeting paper (multilithographed; available to Oct. 1, 1961).

Generalized expressions are derived for the nonisothermal temperature and velocity distributions in a liquid flowing turbulently past a smooth wall. Temperature-dependent fluid properties are represented explicitly in the derived equations. By describing the turbulent eddy properties in a smooth, continuous manner from the wall through all flow sublayers, the same velocity or temperature equation is made to apply at all distances from the wall.

The resulting equations are applicable to liquids of any Prandtl number and are used to compute nonisothermal friction factors for various heating conditions at the wall. Plots of the ratio of nonisothermal to isothermal friction factor as a function of the wall heating condition and bulk Reynolds number are presented for two nuclear reactor coolants: light water and diphenyl. Application of the analysis to a liquid metal shows the temperature variation across the flow path to be sufficiently small to permit neglect of nonisothermal effects.

Thermal Conductivity of Some Commercial Iron-Nickel Alloys..60—WA-47... By T. W. Watson and H. W. Robinson, U. S. Dept. of Commerce, National Bureau of Standards, Washington, D. C. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Heat Transfer;** available to Oct. 1, 1961).

Recognizing the need for values of thermal conductivity embracing a wide band of temperature above and below room temperature, the National Bureau of Standards, in co-operation with the International Nickel Company, made determinations of the thermal conductivity of a number of commercial iron-nickel alloys.

Results of laboratory determinations of thermal conductivities in the temperature range −150 to 540 deg C are presented for 12 iron-nickel alloys. Six samples are of low nickel content, in the range from 1 to 9 per cent, and six others have nickel contents in the range from 35 to 80 per cent. A sample of AISI 1015 steel is included for comparative purposes.

The determinations were made on bar specimens about 2.54 cm in diameter and 37 cm long, by an absolute steady-state method with heat flowing longitudinally in the bar. Computation of results from observed data was effected by means of a digital computer.

Fully Developed Pressure Drop in Triangular Shaped Ducts..60—WA-100... By L. W. Carlson, Rocketdyne, Canoga Park, Calif.; and T. F. Irvine, Jr., Mem. ASME, North Carolina State College, Raleigh, N. C. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Heat Transfer;** available to Oct. 1, 1961).

The purpose of the investigation reported here was to obtain pressure-drop data for duct shapes that were more extreme than those investigated by Deissler and Taylor and thus presented a more critical test of their analysis technique. These measurements were made on ducts with narrow isosceles triangular cross sections. It was also suspected from the nature of the flow in narrow corner regions that large deviations might be expected from the use of the hydraulic diameter rule for such shapes. Such deviations had been observed previously on similar ducts and reported.

Friction factors were measured therefore for isothermal, fully developed, laminar and turbulent flow in smooth isosceles triangular ducts having apex angles that varied from 4 to 39 degrees. Comparisons were made between the measurements and the values predicted by Deissler and Taylor for apex angles of 12 and 22.3 degrees. The calculations predicted that the friction data should fall below the circular tube line which agreed with experiment, although the quantitative comparison was not good. The hydraulic diameter rule was in error by 4 per cent for the apex angle of 38.8 degrees and by 20 per cent for the 4-degree apex angle.

Dynamic Response of Heat Exchangers Having Internal Heat Sources—Part IV.. 60—WA-127... By W. J. Yang, Mitsui Engineering and Shipbuilding Company, Tamano, Okayama, Japan; J. A. Clark, Assoc. Mem. ASME, and V. S. Arpaci, University of Michigan, Ann Arbor, Mich. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Heat Transfer;** available to Oct. 1, 1961).

The dynamic response of a heat exchanger having a sinusoidally time-dependent rate of internal heat generation is investigated. Results for both the transient-periodic and the steady-peri-

odic, or frequency response, are given. These results include the response of the wall and fluid temperatures and the wall-fluid temperature difference. A phenomenon of resonance in the amplitude ratio and phase shift is disclosed. Analytical results are obtained through the use of the Laplace transform technique. Experimental results are presented which compare favorably with the theoretical analysis. Heat exchangers to which these results apply include the heterogeneous nuclear reactor.

Film Boiling Heat Transfer From a Horizontal Surface..60—WA-147...By P. J. Berenson, Massachusetts Institute of Technology, Cambridge, Mass. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Heat Transfer;** available to Oct. 1, 1961).

Taylor-Helmholtz hydrodynamic instability and its significance with regard to film boiling heat transfer from a horizontal surface is discussed. It is shown that, near the minimum film boiling heat flux, the bubble spacing and growth rate are determined by Taylor instability neglecting the effect of fluid depth and viscosity. Utilizing a simplified geometrical model, an analytical expression for the heat-transfer coefficient near the minimum in film pool boiling from a horizontal surface was derived. Combining this equation with the available correlation for the minimum heat flux yields an analytical equation for the temperature difference at the minimum, which defines the location of the minimum point. The foregoing equations agree with the available experimental measurements made on n-pentane and carbon tetrachloride within ±10 per cent.

Film Boiling in a Forced-Convection Boundary-Layer Flow..60—WA-148...By R. D. Cess, Assoc. Mem. ASME, North Carolina State College, Raleigh, N. C.; and E. M. Sparrow, Assoc. Mem. ASME, University of Minnesota, Minneapolis, Minn. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Heat Transfer;** available to Oct. 1, 1961).

Previous analytical studies of film boiling have been concerned with the situation where the fluid motion is generated by gravity forces and forced convection is absent. In the present analysis, consideration is given to film boiling in forced-convection boundary-layer flows where gravity forces are negligible.

It is shown that the resulting two-phase flow problem can be formulated exactly within the framework of laminar boundary-layer theory. Solutions covering the parameter range of practical interest have been obtained by a combination analytical-numerical method. Heat-transfer and skin-friction results are presented both graphically and as simple, closed-form analytical expressions. Relative to the case of pure liquid flow, the skin friction is substantially reduced due to film boiling. The heat transfer is found to increase as $(\Delta T)^{1/2}$, a much smaller dependence than in other convection phenomena.

Correlation of the Total Emissivity of Carbon Dioxide and Water Vapor..60—WA-175...By J. T. Bevans, Mem. ASME, Shell Development Company, Division of Shell Oil Company, Emeryville, Calif. 1960 ASME Winter Annual Meeting paper (multilithographed; available to Oct. 1, 1961).

The use of the exponential transmission function (Beer's law) to describe the thermal-radiation characteristics of gases has been shown to be incorrect for the total-energy case.

Inherent in the improvement of present methods of analysis of radiant heat transfer is the determination and validation of the correct absorption (or transmission) "laws" for gases. A recent examination of gaseous radiation characteristics has reviewed the theoretical and experimental evidence and proposed the introduction of new absorption functions. These new functions are important in the computation of the geometrical factors.

One purpose of this paper is to test and verify the proposed "laws" prior to the use of these laws for computations. The proposed expressions have been applied satisfactorily to the published data for the emissivity of carbon dioxide and water vapor over a temperature range of 800 to 3600 R.

Experimental Ablation Rates in a Turbulent Boundary Layer..60—WA-208...By E. P. Bartlett and M. R. Denison, Aeronutronic, Division of Ford Motor Company, Newport Beach, Calif. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Heat Transfer;** available to Oct. 1, 1961).

An effective means of absorbing the high heat fluxes of re-entry is through the mechanism of ablation: melting and vaporization or sublimation of the surface of the thermal shield.

An exploratory experimental program on the ablation of graphite, a combustible sublimator, is reported. It verifies an analysis of turbulent ablation rates previously developed. A blowdown system was employed using a mixture of oxygen and nitrogen as the working gas. The use of a high percentage of oxygen enabled the simulation of re-entry ablation conditions. Ablation rates were predicted within 30 per cent with no adjustment of empirical constants derived from incompressible turbulent skin-friction experiments. The predictions were consistently high. Temperature of the reacting surface, determined by means of a radiamatic pyrometer, was predicted to within 10 per cent. The analysis can be applied to a wide variety of ablation materials including those which go through a liquid phase, provided proper account is taken of the chemistry, and provided the simplifying assumptions are valid.

An Exact Solution of the Compressible-Flow Characteristics in Constant-Area Passages With Simultaneous Friction and Constant Heat Flux..60—WA-177...By R. N. Noyes, Mem. ASME, General Electric Company, Cincinnati, Ohio. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Heat Transfer;** available to Oct. 1, 1961).

An exact solution is presented for the flow of a compressible fluid in a constant-area passage in which wall friction is present and the total temperature of the fluid rises linearly with distance through the passage. For fluid properties that are invariant with temperature, this is specifically the case of constant heat flux. From this exact solution, an approximate simplified form is derived that should be applicable to predicting flow performance for most types of operation of constant-area heat exchangers.

On Some Laminar Forced-Convection Problems..60—WA-188...By L. N. Tao, Assoc. Mem. ASME, Illinois Institute of Technology, Chicago, Ill. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Heat Transfer;** available to Oct. 1, 1961).

The forced-convection problems in channels of fully developed laminar flow with heat sources and constant wall-temperature gradient are approached by the method of complex variables. It is shown that the stated problems are reduced to the determination of some analytic functions which satisfy the boundary conditions. Few basic problems, including flows in equilateral triangular ducts and in elliptical tubes, are studied. Also, it is shown that the cases of circular tubes and of parallel plates with a gap are directly deducible from that of elliptical tubes. All these solutions are expressed in closed forms by polynomials.

Local Mass Transfer From Circular Cylinders in Cross Flow..60—WA-193...By H. H. Sogin, Mem. ASME, Tulane University, New Orleans, La.; and V. S. Subramanian, Union Carbide of India, Ltd., Calcutta, India. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Heat Transfer;** available to Oct. 1, 1961).

This is an investigation of the distribution of the local rate of mass transfer

from 4.2-in-diam naphthalene cylinders to air at ordinary temperature and pressure, flowing normal to the axis. The air speeds are near and within the critical zone of the drag. The results in the laminar region are compared with approximate boundary-layer calculations of H. Schuh and of H. J. Merk and with corresponding heat and mass-transfer experimentation in the literature. It is shown that the calculations after Merk are reliable from the point of stagnation to the predicted point of separation.

Transient Temperature in a Melting Solid ..60—WA-277... By J. E. Sunderland, Assoc. Mem. ASME, Northwestern University, Evanston, Ill.; and R. J. Grosh, Assoc. Mem. ASME, Purdue University, Lafayette, Ind. 1960 ASME Winter Annual Meeting paper (multilithographed; to be published in **Trans. ASME—J. Heat Transfer;** available to Oct. 1, 1961).

A method of analysis is given for determining the temperature distribution in a semi-infinite, homogeneous solid initially at a constant temperature and then suddenly heated by convection so that a phase change occurs and the new phase is removed upon formation. The method appears applicable to problems involving melting, freezing, or sublimation and to situations where the environment temperature and heat-transfer coefficient vary.

It consists of calculating the temperature before the phase change occurs, during the transient process of phase change, and after steady-state conditions are obtained if such is possible. During the transient process, a numerical or graphical method of solution may be used which is an extension of the Binder method. Numerical results obtained with a digital computer are given for the case where the environment temperature and coefficient of heat transfer are constant and provide a method for determining the velocity and position of the moving phase front.

An Integral Treatment of Two-Phase Boundary Layer in Film Condensation.. 60—WA-253... By J. C. Y. Koh, Boeing Airplane Company, Seattle, Wash. 1960 ASME Winter Annual Meeting paper (multilithographed; available to Oct. 1, 1961).

By using the integral method, the task of solving the complicated two-phase boundary-layer differential equations in laminar-film condensation has been reduced to the simple work of solving an algebraic equation.

The purposes of this paper are: To develop some simplified equations for the solution of the two-phase film condensation problem, and to seek to explain analytically that the $\rho\mu$ ratio between the liquid and vapor does not have a significant effect on condensation heat transfer. It is believed that the present method can be used to solve the analogous two-phase boundary-layer problem in laminar film boiling.

Flow-Visualization Studies of Transition to Turbulence in Free-Convection Flow.. 60—WA-250... By E. R. G. Eckert and J. P. Hartnett, Mem. ASME, University of Minnesota, Minneapolis, Minn.; and T. F. Irvine, Jr., North Carolina State College, Raleigh, N. C. 1960 ASME Winter Annual Meeting paper (multilithographed; available to Oct. 1, 1961).

Turbulent flow being a three-dimensional process, only limited information can be obtained from interferograms. For this reason, the available flow-visualization studies with the interferometer were supplemented by a study in which the flow was made visible by the introduction of smoke threads into the boundary layer. The process of natural transition in a free-convection boundary layer, as well as the effects of a single roughness element on the flow, were studied visually and were recorded in motion pictures.

Buoyancy Effects in Forced Laminar Convection Flow Over a Horizontal Flat Plate..60—WA-220... By Yasuo Mori, Cornell University, Ithaca, N. Y. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Heat Transfer;** available to Oct. 1, 1961).

Effects of buoyancy forces in a forced laminar convection flow over a horizontal flat plate is analyzed. It is shown that the solutions may be expanded into power series in $Gr_x/Re_x^{2.5}$ whose first terms express the solution for the purely forced convection flow. A numerical example is given to show the effects of Grashof number on the velocity and temperature profiles, and the Nusselt number.

ASME TRANSACTIONS

The December, 1960, issues of the Transactions of the ASME—*Journal of Basic Engineering* and *Journal of Applied Mechanics* (available at $1.50 per copy to ASME Members; $3 to nonmembers) —contain the following:

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784 The Selection of Length and Head Scales for Cavitation Tests, by Pierre Danel and Jacques Duport. (59—A-40)

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808 On Cathodic Protection in Cavitation Damage, by M. S. Plesset. (59—A-170)

821 Correlation of Cavitation Inception Data for a Centrifugal Pump Operating in Water and in Sodium-Potassium Alloy (NaK), by A. G. Grindell. (59—A-156)

829 The Creep-Rupture Properties of 80 Ni-20 Cr Alloys, by Robert Widmer and N. J. Grant. (59—A-119)

839 The Extrapolation of Families of Curves by Recurrence Relations, With Application to Creep-Rupture Data, by A. Mendelson and S. S. Manson. (59—A-155)

848 Some Observations on the Extrapolation of High-Temperature Ferritic Steel Data, by R. M. Goldhoff. (59—A-133)

855 Fabrication and Annealing Factors Affecting Grain Size of 18Cr8Ni-Ti Superheater Materials in Steam Boilers, by F. Eberle and J. S. Makris. (59—A-311)

867 Survey of Various Special Tests Used to Determine Elastic, Plastic, and Rupture Properties of Metals at Elevated Temperatures, by F. Garofalo. (59—A-112)

882 The Role of Atmosphere in the Creep-Rupture Behavior of 80 Ni-20 Cr Alloys, by Robert Widmer and N. J. Grant. (59—A-122)

887 Bourbon Tube Deflection Characteristics, by P. G. Exline.

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899 A Note on the Influence of Elastic Compliance on Sliding Friction in Ball Bearings, by K. L. Johnson. (60—LubS-2)

901 Pressure Oscillations in a Water-Cooled Nuclear Reactor Induced by Water-Hammer Waves, by P. Lieberman and E. A. Brown. (60—Hyd-2)

912 Pressure Surges in Pipelines Carrying Viscous Liquids, by W. T. Rouleau. (60—Hyd-5)
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929 An Experimental Study of Cavitation in a Mixed Flow Pump Impeller, by G. M. Wood, J. S. Murphy, and J. Farquhar. (60—Hyd-7)
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640 Sinusoidal Excitation of a System With Bilinear Hysteresis, T. K. Caughey. (60—APM-8)
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Mechanical Engineers—5000 Strong—Move Into National

THE 81st Annual Meeting—now known as the Winter Annual Meeting—of The American Society of Mechanical Engineers took place Nov. 27–Dec. 2, 1960, at the Statler Hilton Hotel in New York, N. Y. Total registration of engineers, their wives, and guests was 5200. Concurrently, the 24th National Exposition of Power and Mechanical Engineering was held at the New York Coliseum.

It is a commentary on the times that nobody proposed a theme for the Winter Annual Meeting. We are in a phase where we are supposed to be unsure of our goals, the whole nation gasping for moral air, groping, limp with confusion. The revolutionary goals of "life, liberty, and the pursuit of happiness" are no longer enough for us, perhaps because they are now too easily achieved—and also because they're not broad enough or muscular enough for a nation with global responsibilities.

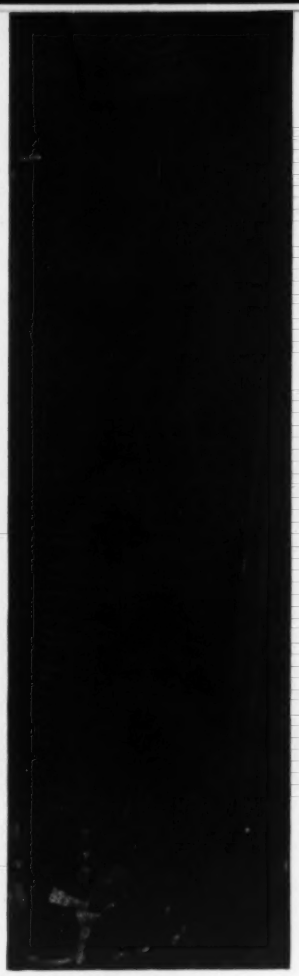
But there are always goals when several thousand mechanical engineers gather under one roof to exchange hard-won information, to lift the level of engineering capability, to brace the profession for the advances to come. These are the men whose work will give us the power to defend ourselves and others, and the means of making good on the promise that science has made to the world's underdeveloped nations. If these men do their work well, we shall take up the slack in our international prestige, and we shall continue to enjoy the privilege of worrying about our personal goals.

Because they are mechanical engineers, their work is of first importance in the areas in which extreme temperatures, extreme velocities, and extreme stresses are critical. That means, among other things, nuclear power, rockets, space travel. It is the day of the mechanical engineer.

If the meeting seemed to lack focus, this was due to an accident of time. There are three phases of engineering development. In the first, a new possibility has emerged and we are struggling to establish a foundation. In the second, engineers are making strides in the solution of new problems, and nobody is sure who is on the right track. In the final phase, we consolidate our gains. In 1960, it happened that all three phases were present in different sections of the art represented by the 24 Divisions of ASME. Under the title "Technical Program High Lights," the reader will find detailed discussions of the activities of the Divisions.

A 1960 plus for engineering was the public respect which grew throughout the year. The satellite Echo traversed the sky, visible to millions of naked eyes, opening eyes and minds. That helps.

What did the members, personally, get from this meeting? Beyond the bald technical information, there are subtle



Spotlight in NYC

values. Morale goes up. Nowhere else does an engineer get the recognition he needs and is entitled to—not from management, and not yet from the public. The desire to learn, which brings these leading engineers together, is a powerful force; there is a thrill to it. One member said what so many have felt, down through the years of Society activity: "I feel stronger."

Here was that "good intellectual climate" that Herbert Hoover says can be found at itsbest in New York.

For the Society, the Winter Annual Meeting is also a time of executive decisions and the installation of new officers. William H. Byrne, president of Byrne Associates, became President of ASME for 1961 and for an interim term in 1962 caused by a change in the Society's administrative year.

In the following pages, we report the high lights of the 1960 Winter Annual Meeting.

ENGINEERING IN 1985

A PANEL discussion of "What Engineering Will Be in 25 Years—From the Viewpoint of Industry and the Practical Engineer," was presented at the Joint Conference of Council, Boards, and Committees on Sunday evening.

C. A. Jurgensen, Mem. ASME, vice-president of manufacturing, DeLaval Steam Turbine Company, opened the discussion, stating that while it is difficult to predict what type of power, for example, will predominate in 1985, some major trends in engineering are evident. It is clear that not one, but a score, of "industrial revolutions" is taking place—in research programming, in the management of paper work, in transportation, in electronics and communication, and, "even though we don't like to talk about it," in the art of warfare.

Concurrently with this technological change, changes are taking place in the practice of engineering. One is the growing importance of the effect of the engineer's work. The engineer of the future—particularly in the small company—will have to accept the responsibility for the sociological impact of his work. Related to this are the increasingly important environmental factors—less noise, less vibration, shielding against cold, heat, and radioactivity—and the greater attention to safety, and pollution effects.

The gap between the thinker and the doer—the engineer-mechanic relationship—is widening more and more as the engineer is being trained for increasingly complex thinking. Shop supervision, now manned by engineers, could well be turned over to technical-school graduates.

To prepare the engineer for his future role, close co-operation will be necessary between industry and education to bring about a proper balance between skill courses and those which teach principles.

A major technological upheaval is taking place in which the broad, embracing technical society, rather than the splinter group concerned with one small area of engineering, will have an important place. Organizations like ASME will be in a position to provide a focal and collating point, since they will have a broader view of new developments.

Both Mr. Jurgensen and Dean M. P. O'Brien, who spoke later, emphasized the importance of what Dean O'Brien called world-wide competition—both an economic and a military war—"which we must win on both counts." In this it will be a difficult struggle to maintain, let alone increase, our standard of living and we are not going to be helped for long by patents or trade agreements.

Mr. Jurgensen stated that we must outproduce our competitors even though they have a lower wage rate than we do, and this is an engineering problem. Production control must be mechanized. The level of our selling efficiency, and its correlate—linguistic ability—must be raised. Our competitors, by and large, speak their customers' languages fluently. We also have to learn not to overdesign to the extent that we do in some cases, where we waste metal in order to provide a sense of ruggedness.

Mr. Jurgensen stated that engineers must also improve their communications with nontechnical people. Dean O'Brien stated that this is particularly important in the disparity between those who have knowledge and those who have authority at the decision-making level.

J. A. Haddad, general manager, Advanced Systems Design, IBM, stated that the words "practicing engineer" in the discussion title required a change in semantics. Practicing engineers are now being used for both research and manufacturing. Even manufacturing design is no longer the province of industry. The nonacademic parts of universities—the various research institutions like Stanford, Lincoln Laboratories, and similar groups—are heavily involved. Intermingling is also going on in the subject matter of research, where a lot more basic science and sociology are being mixed with engineering.

The "two cultures"—liberal-arts oriented and technology oriented—are blending, now that the public has to know more technology. The engineering disciplines are also losing their identity. Once he has graduated, the EE, the ME, or the CE tends to do the same type of work within the functional categories of sales, manufacturing, and product improvement.

The lonely inventor has been replaced by the research team, but individual creativity will reassert itself. However, the job of actually getting an idea to the production stage will be even more of a group effort than it is now. En-

gineers also are being backed by more costly preliminary procedures and using more sophisticated and expensive tools. This backing-up is now estimated to cost two to three times his salary and may go to as much as five times.

Technology used to turn around completely and become obsolete in 25 or 30 years. This obsolescence may accelerate until it requires only five or ten years. Engineers will have to develop keeping-up techniques. For this, learning the "language" of science and engineering and the proper habits of thought and analysis will be extremely important. The management aspect of engineering also will assume increasing importance.

L. Ray Crittenden, Mem. ASME, director, Mechanical Development Laboratory, E. I. du Pont de Nemours & Company, Inc., "an EE and an ME working in a chemical industry," stated that there is some fear that research will advance too fast for us to be able to pass it on to the next generation. Increased specialization is needed, but there is also a great need for the engineer who can visualize what must be done, find the proper pieces, and put them together. To aid in this process, greater simplification of the basic scientific principles is needed—simplification or codification of the basic facts of science.

While we must provide the means and the challenge for some to specialize, we need to instill "divine discontent" and the drive to creativity in others.

M. P. O'Brien, Mem. ASME, dean-emeritus, University of California, who has also had broad experience in consulting practice, stated that in 1985 hardware, structures, and system design still will be needed, but the specific types are unpredictable.

How we got where we are is important! We had an unoccupied country with resources to exploit under a ready-made political system capable of being changed, and were populated by immigrants who were used to hard work, and these all coincided with the industrial revolution. This combination of factors will not exist again for us, or elsewhere. The drive is now spent, and to a large extent we are benefiting from and coasting on the work of others.

In the competitive struggle that we are facing, we must have the capacity to acquire new knowledge and the ability to apply it to developing new and better products at a competitive price.

Translating that job into a proper educational program occupied much of the discussion period which followed.

Newman A. Hall, Mem. ASME, head of the Mechanical Engineering Department, Yale University, and chairman of the ASME Board on Education, which sponsored the program, served as chairman of the panel discussion.

TECHNICAL PROGRAM HIGH LIGHTS

No less than six of ASME's 24 Divisions celebrated their 40th anniversaries this year. They were: Aviation, Fuels, Management, Materials Handling, Power, and Railroad. All of these were founded in 1920.

At the Winter Annual Meeting, engineers attending technical sessions and panel discussions found the many disciplines in different stages of the engineering cycle. Sit in on a certain evening session in which the teaching of machine design was discussed, and you found mechanical engineering in grave difficulties, seeking a new base from which to take off. The problem is to teach undergraduates (and persuade them to learn) to design machinery that works. This is becoming a lost art, and the problem will get worse before it gets better. In the words of Saroyan, "No foundation, right down the line." Another year, and this problem will be in the forefront, with solutions.

On the other hand, attend sessions on solar energy, and you found a Division happily in the hardware stage of the cycle, designing power into space vehicles, enjoying its first practical success. Somewhere in the middle, one might find the problem of corrosion and deposits in boilers and gas turbines. This problem gets solved, then unsolved, as temperature and pressure ratings go up and fuels get worse. (In coal, the alkali metals; in oil, the vanadium content.) They will put out that fire—and then along will come MHD, and the problem will blaze up again.

Not all technical papers originate in the Divisions. The work of the Society's Research Committees—the ASME-sponsored research—ends always in publication. Research projects run from six months to three years, and currently there are 15 projects under way, involving some $400,000 in money plus contributed services and contributed facilities. Publication takes the form of "progress reports" and "final reports," and both types were presented.

There were 406 technical papers, presented at 122 sessions. An availability list of the papers—authors, titles, and ASME numbers—appears in this issue, pp. 117–121. In addition, all papers which are not scheduled for publication in Mechanical Engineering will be abstracted in the "ASME Technical Digest," some in this issue, others in succeeding issues.

ASME encompasses 24 Divisions and 21 Research Committees. The following report points up trends and activities in some of those that presented papers at the Winter Annual Meeting.

Engineering for Industry

Aviation. The Aviation Division is celebrating its fortieth anniversary. ASME was the first technical society to recognize the aviation industry, and technical papers presented at the Meetings and Conferences have been the first revelations to the industry of major breakthroughs in aeronautical design.

Over the years, papers on propulsion have progressed from reciprocating engines to jet engines to solid-fuel rocket engines to liquid-fuel rocket engines to nuclear-powered ion and photon engines used with magnetohydrodynamic accelerators or nozzle pinchers. Examples of today's papers in propulsion are three of the Winter Annual Meeting papers: "Electrical Propulsion Applications and System Requirements," "The Application of the Pinch Process for Space Propulsion," and "Low-Thrust Propulsion for Mars Transfer Mission."

Major changes have also occurred not only in the aerodynamic design but the materials of air frames. We have seen the transition from the wood-and-wire airframe of the early years, to aluminum, to stainless steel, titanium, molybdenum alloys, and, for re-entry bodies, ablative materials. Instrumentation and guidance are other areas of major change, going from almost zero in the days of the Wright brothers to approximately 50 per cent of the material cost of a major missile system today.

Among other outstanding papers at this meeting were "Application of the Thin-Shell Theory of Antenna Design," and "The Use of a Centrifuge for the Precision Measurement of Accelerator Characteristics."

Whereas ASME sessions are intended to make solid contributions to the advancement of the state-of-the-art, and have always done so, it is clear from these papers that the Division intended to keep its members informed on the exotic problems of the future.

Machine Design. Of the authors represented at the Machine-Design sessions, fourteen are associated with universities, thirteen with industry. To this basically sound representation of contributors, add a broad spectrum of subject matter: Eight papers dealing with vibration theory and its applications; three on stress analysis; three on power transmission; two in the area of kinematics, including a German-English glossary for students of kinematics (this glossary appeared in the December, 1960, issue of MECHANICAL ENGINEERING); two dealing with the design of springs; one with frictional characteristics of molded materials; one with the magnetic properties of malleable irons.

More and more, analytical methods are being applied to the solution of design problems. The papers reflected the interest in means of solving specific problems, and in specific analytical approaches.

There was increasing emphasis on operational environment, and the more stringent requirements of extreme environments and new structural materials. These factors reach their height in the design of space vehicles, where volume and weight are critical, and designs must be optimized as never before. Quantitative understanding of materials and phenomena must be accelerated to insure the future role of the mechanical designer.

Management. Score 40 years of achievement for the Management Division, too. If, as Peter Drucker says, "The history of management properly begins only fifty years ago," ASME's Management Divisions has been an organized entity most of that time. In point of fact, ASME can be said to have been the pioneer in the scientific approach to management.

Quoting Mr. Drucker again: ". . . the decade of the fifties has been a time of fulfillment in management. . . . 'managing' as a distinct kind of work, the 'manager' as a distinct organ of and function in society, and 'management' as a specific area of thought and study are new." The quote is from a paper delivered by Mr. Drucker at the Winter Annual Meeting.

The five principal sessions of the Management Division were, in effect, a comprehensive progress report on the past ten years in the management field. Lead-off speaker was Mrs. Lillian M. Gilbreth, famed pioneer in management engineering. Altogether, there were 20 of these Golden-Jubilee-of-Scientific-Management papers, and the entire ten-year report is available in a cloth-bound volume, which also contains the four previous ten-year reports. The book, "Fifty Years' Progress in Management," sells to ASME members for $8.40; to nonmembers for $10.50.

Maintenance and Plant Engineering. It is now three years since maintenance and plant engineering was recognized as a Division. The majority of papers to date have dealt with maintenance rather than plant engineering. This is logical, considering the current emphasis on maintenance in industry.

It is doubtful that a definite, long-range trend will develop in this Division, since the interests within the Division encompass nearly all fields of engineering. At the Winter Annual Meeting, papers dealt largely with the analytical and planning aspects of plant engineering, rather than with the more mundane fields of maintenance and plant repairs. One of the papers was noteworthy in revealing a new concept of machine data processing and methods of analysis of such data to reduce down time. This procedure could be applied to all types of production machinery with resultant savings of down time and increasing production.

Another of the papers revealed a new method of determining, by ultrasonic methods, wastage of heater tubes in large steam generators.

Materials Handling. Industry has begun to apply the techniques of automation in the materials-handling field. Sophistication of control has grown considerably in warehousing. Automatic dispatching of finished products to storage locations, and recall in quantities and assortments needed by the shipper, are being accomplished through the intelligence placed on a punched card or tape.

In keeping with the advances within the field, the Materials-Handling Division sponsored two sessions at the Winter Annual Meeting. Subject matter ranged from synchronization of conveyer drives to methods engineering, from bulk-materials handling to mechanized warehousing. The choice between the fork truck and the trailer train came in for analysis.

Although this is one of the 40-year Divisions, it will hold its first independent technical conference in 1961—in Minneapolis, Minn., in October. This conference will be in the nature of a symposium, with technical papers, work shops, group discussions, and exhibits.

Production Engineering. What are the men of the Production Engineering Division seeking in their investigations? Metal cutting has, in the past, been a strong and popular subject, and continued so this year. Basic research on chip formation continued to hold the stage, as well as studies on chipless machining. One of the more interesting papers on machinability was "Fundamental Machinability Research in Japan," by Katsundo Hitomi, from the Department of Mechanical Engineering, Kyoto University, Kyoto, Japan.

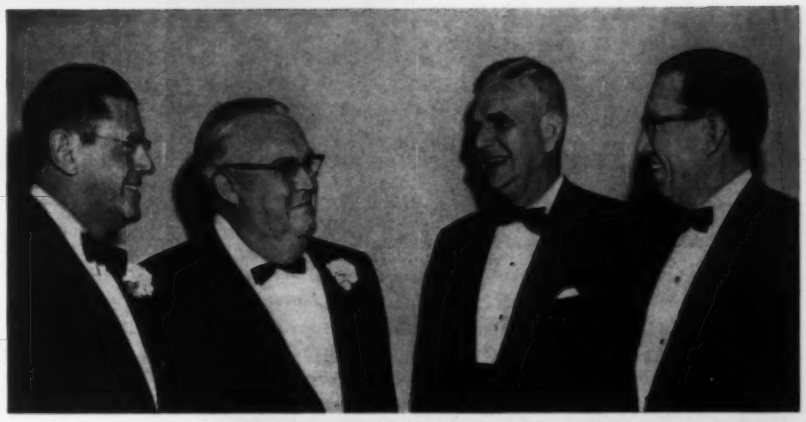
The Division's large scope of subjects make it almost impossible to state a trend for the total Division. The atomic and missile developments have influenced the subject matter, as evidenced by a paper on "Sandwich Brazing of Columbium Alloys," to be applied to re-entry

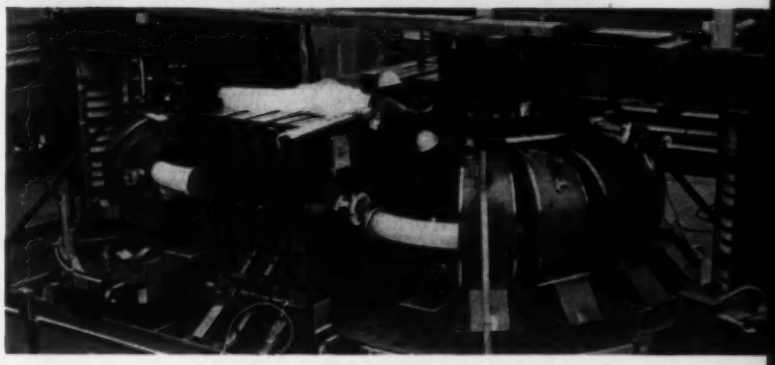
1960 ASME WINTER ANNUAL MEETING

The Winter Annual Meeting brings together leaders in engineering. Of all who have given their best in support of the aims and activities of ASME, none is more honored than Dr. Lillian M. Gilbreth, management engineer extraordinary. Mrs. Gilbreth is a Fellow and Hon. Mem. ASME: Her membership began in 1926. She is, of course, the widow of the famed pioneer in scientific management, and such is the legend of the Gilbreths that she has seen her early life depicted in books and in the movies. (The management term "Therblig," meaning a component part of the cycle of motions in a workman's operation, is an anagram of the name Gilbreth.) She is president of Gilbreth, Inc., of Montclair, N. J. The photo was taken at the Business Meeting. She also presented a technical paper at a Management Session, and contributed to the book "Fifty Years' Progress in Management."

ASME members and guests board bus for one of five inspection trips held during Winter Annual Meeting week

Shown at Banquet are **left** to **right:** ASME Secretary O. B. Schier, II; Incoming President W. H. Byrne; Henry Heald, who was made Honorary Member of ASME; and Dean H. A. Bolz of the Board on Honors





C Stellarator being assembled highlighted trip to Project Matterhorn Laboratory at Princeton University

Martin Goland, President of Southwest Research Institute, enjoys moment of relaxation

Helmut Pessen, **left,** accepts Blackall Machine and Tool Gage Award for his brother David and for J. B. Popper from ASME Past-President F. S. Blackall, jr., **center.** Outgoing President W. L. Cisler looks on.

vehicles, and a paper on "Weld Qualities in Plutonium Plant," which has atomic applications.

Two papers also were presented on the plasma arc torch for metal cutting. In general, papers ran the gamut from the measurement of milling forces with a planetary-gear torquemeter, to new developments in the theory of the metal-cutting process.

Railroad. The Railroad Division, also one of the six 40-year divisions, can say with complete assurance that its papers are commanding greater and greater interest with each meeting. The railroads are faced with severe competition and regulation, pressed by the urgency of developing automated equipment and new types of cars and locomotives to remain competitive with other modes of transportation. There has been, and is, keen interest in the ASME papers that detail the background of new equipment and programs for improvement in the mechanical engineering of new facilities. This year they had a paper on the progress of Russian railroads: It is a matter of urgency to get some insight into progress behind the iron curtain.

There were papers on equipment such as the "railvan" and push-pull suburban trains. There was an outstanding paper on stresses in cars used for "trailer-on-flatcar" service, commonly known as "piggyback." One paper covered a new diesel engine for locomotive use.

Major emphasis continues to be placed on the modern technologies of automation and electronics. In the furtherance of this trend, the Division has cosponsored an annual Railroad Conference with the Land Transportation Committee of the AIEE. Future conferences are planned through 1964 and are part of the continuing effort of the Railroad Division to present the latest in technical advances to its members.

Safety. There are those who believe that ASME's greatest contribution to engineering has been in the field of safety (boiler codes, elevator codes, etc.).

What is going on, today? The codes, of course, never cease to grow and develop: That is an unceasing labor of the standing committees. But what is the Safety Division presenting at its sessions? There were five sessions: "Safety and people," which took up the mental functions as they work for safety, and a paper on resuscitation and breathing protection; a panel discussion on industrial noise, evaluating the noise exposure of men in industrial plants; two sessions held jointly with Nuclear Engineering, on safety in the use of radioisotopes (one of these papers will appear in a later issue of MECHANICAL ENGINEERING); and a session on industrial ventilation. This last paper appears in this issue, pp. 39–42.

Petroleum Once, crude oil was used as a patent medicine. The kerosene lamp and axle grease followed closely. It was a living.

At the 1960 Winter Annual Meeting, ASME's Petroleum Division held three technical sessions plus a fourth held jointly with Metals Engineering. The first session heard a paper entitled "Natural Gas, the Pipeline Industry," in which the author made the point that natural gas, a waste product in the days of the kerosene lamp, is now the basis for our fifth largest industry in terms of capital investment. See this issue, pp. 26–30.

Other sessions took in discussions of the Pressure Vessel Code—with suggestions for further development of the Code—and stresses in pipe and joints. With Metals Engineering, they went into problems of the bursting of tubular specimens by gaseous detonation, thermal stress in irregular shapes, and a theory of fatigue damage.

We keep getting back to heat transfer, which is, of course, a basic element in petroleum operations. When fins are used to increase heat transfer, convection occurs along the fin. One paper studied the nonuniform convective heat-transfer coefficient that develops.

Process Industries. In its three sessions, the Process Industries Division covered a curiously wide range of subject matter. It went all the way from the gravity flow of bulk solids to the value analyzing of a complex product, from low-temperature refrigeration to the operation of a municipal refuse incinerator.

The first session was held jointly with the Management Division. That was the one in which papers were presented on value engineering—a grimly vital part of the engineering process in these days when competition is bearing down, when customers want nothing that is not functional: They want value for their money. Value engineering may be considered a new and critical phase of engineering.

Other sessions covered such process subjects as fine grinding, flow of bulk solids, refrigeration, and the characterization of industrial fabric filters.

Engineering for Power

Nuclear Engineering. Three of the four Nuclear sessions were cosponsored by the Power Division, and a fourth on the use of radioisotopes was cosponsored by the Safety Division. Two unpreprinted panel discussions were given—one on direct conversion to electricity, the other on the current status of a number of reactors.

Direct Conversion. C. Guy Suits, vice-president and director of research, General Electric Company, was chairman of the session on the four principal approaches to direct conversion. Harvey A. Wagner, Mem. ASME, assistant vice-president and manager of system development, the Detroit Edison Company, was vice-chairman.

Robert W. Pidd of General Dynamics stated that nuclear thermionic conversion, in a typical example with selected attainable parameters, uses a 180-C cathode suspended from a stem in a hollow cylinder whose walls serve as a

300-C anode. The space between them is fed through an opening in the bottom with vapor from a 250-C cesium pool. The cathode is generally UC or ZrC. These have the ideal properties: (*a*) Refractory material, (*b*) conductor, (*c*) strong and durable, (*d*) excellent thermionic emission in the case of UC. The anode is generally cesium or nickel. Output in the example used would be 8 amp per sq cm for an input of 26 watts per cm, giving an efficiency of 24 per cent.

There is also the possibility of a-c generation although the frequency is intrinsic and not easily controlled. It would be in the radiofrequency range.

The first application will be d-c for space vehicles. Central stations are not foreseen now, but within a year it will be known whether they are feasible.

In thermoelectric power generation, described by F. H. Horn of General Electric, one junction of a thermoelectric pair is heated and the other cooled, resulting in a flow of current. The SNAP family of nuclear-auxiliary-power devices belongs to this group and Westinghouse has a 5-kw non-nuclear unit. Efficiency—16 to 18 per cent conversion is considered good—drops rapidly above 200 C. The source of heat, mechanical strength, and impurities problems at high temperatures are all factors. Thermoelectric heating and cooling are receiving attention and will contribute to development for power generation.

Fuel cells, according to Will Mitchell, Jr., of Allis-Chalmers, are of a wide variety of types utilizing gaseous (hydrogen and oxygen), liquid (such as alcohol), or solid fuels; and gaseous or liquid oxidants. One demonstration unit runs on Martinis. The electrolyte may be a solid, a molten salt, or an aqueous solution of a salt. Solid or porous metal electrodes are common, but a liquid may be used if it is conductive. A catalyst must be used and it is usually platinum on the fuel side and cobalt or a nickel oxide on the oxygen side.

Operating conditions may be at high temperatures and high pressures, low temperatures and low pressures, or various combinations. In some, the fuel is incorporated with the electrolyte.

Problems: Voltage and amperage regulation are difficult because of surge loads, getting rid of oxidation products.

Mobile power units are "on the horizon"—tractors, locomotives, road vehicles—but no central-station power yet. Since the number of cells governs voltage and size determines amperage, configurations can be arranged in any form to suit vehicle shape.

Magnetohydrodynamics "in sizes above mere watts" may come into being before any of the other methods, according to Philip Sporn, Hon. Mem. ASME, chairman of the Fuels Division session, in which it was also discussed. A gas, "seeded" with cesium or potassium to provide conductivity, and passing between electrodes, induces an electromotive force due to the difference in potential between the top and bottom electrodes. A contribution is also made by the velocity of the gas. Devising an electrode structure that will stand up in a highly oxidizing combustion-gas atmosphere at the 2000-K temperatures is one of the major problems. The Hall effect, which causes currents to flow off at an angle, raises problems. Heat-transfer apparatus for the higher temperatures is needed. (For more on MHD see the Hydraulic Dinner address by Dr. Kantrowitz, p. 95, and the Fuels Division technical sessions, this page.)

Reactor Status Reports. Current status and operating experience reports with Dresden, Yankee, Enrico Fermi, Indian Point, EBR-II, and Plutonium recycle were presented. A summary will be given in the "Briefing the Record" section of MECHANICAL ENGINEERING for February, 1961.

One completely new reactor concept, a binary-vapor type which would use sulfur as the primary working fluid, was given theoretical treatment. Thermodynamically it has many advantages. Corrosion and viscosity problems with the sulfur would have to be solved.

Fuels Division. The Fuels Division was one of the six ASME Divisions celebrating their 40th anniversary. Philip Sporn, Hon. Mem. ASME, president of the American Electric Power Service Corporation, presided at the session on magnetohydrodynamic power generation which enlarged on the introduction to MHD given by Stewart Way, Mem. ASME, consultant to the Westinghouse Research Laboratories, in the Nuclear Division session on MHD (see above). Both Westinghouse and General Electric are doing research in this area, and Mr. Sporn is twice represented in the group sponsoring MHD research at the Avco-Everett Research Laboratory—three AEP subsidiaries are included in the 10 sponsoring utilities—and he also serves as liaison for the entire group.

MHD should make possible 50 to 55 per cent thermal efficiencies (the present top for conventional plants is 40 per cent), lowered operating costs, elimination of both rotating and heat-absorbing equipment, hence lower capital cost. Not only are the intermediate cycles, boiler, and condenser eliminated, but other thermodynamic equipment is simplified.

A session on furnace safeguards, which continued a series presented in other years, was a panel presentation of the viewpoints on the effectiveness of flame-safety systems by 11 representatives of manufacturers and utilities. The increasing trend toward full automation in industrial and utility power plants has emphasized the need for dependable safeguards of this type.

Other papers covered such subjects as dew-point measurements in boiler-flue gases, formation of nitrogen oxides, and a discussion of fuel selection in the cement industry.

Solar Energy. In addition to the "Progress Report: Solar Energy in 1960," (MECHANICAL ENGINEERING, December, 1960, pp. 41–44), six other papers were presented by the Solar Energy Application Committee. A performance report was given on solar heating in the M.I.T. Solar House IV. Optimization of collector-system design, the design of a lightweight solar concentrator, and performance of silicon solar cells at high levels of solar radiation were hardware and performance topics. Applications considered were a steam generator and the use of image furnaces in research.

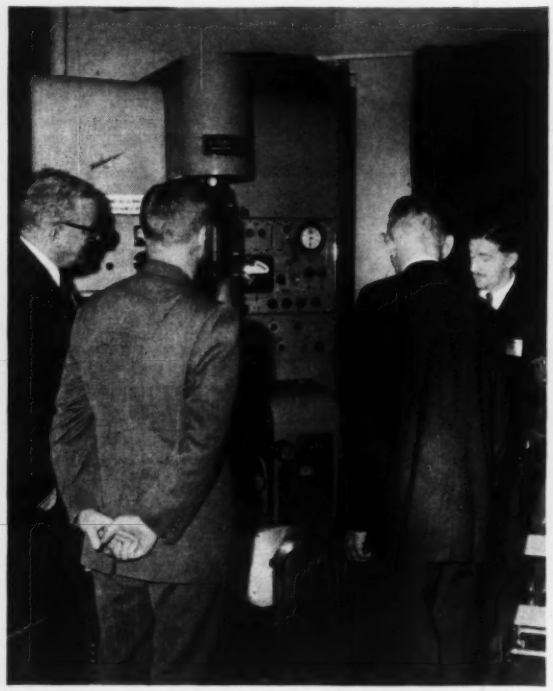
Power. The Power Division, one of the six ASME divisions celebrating their 40th anniversary, sponsored four technical sessions and cosponsored seven others, three with the Nuclear Engineering Division, two with the Fuels Division, and two with the Boiler Feedwater Studies Research Committee.

Two of the papers discussed theoretical aspects and the application of an approach to the monitoring of steam-power-cycle operation, including the identification of faults and determining their cumulative effect on the cycle. The techniques are amenable to the use of tools already at hand, and are advantageously combined with the use of data-processing equipment.

Corrosion and Deposits. Some of the findings of the Research Committee on Corrosion and Deposits from Combustion Gases were reported. The liquid phase of a complex sulfate mixture, formed from the absorption of sulfur in high sodium and potassium-content coals, was identified as the cause of an accelerated boiler-tube corrosion rate between 1050 and 1300 F. The addition of ammonia to flue gas in a large pulverized-coal-fired boiler minimized air-preheater corrosion at metal temperatures above the water dew point. A low-melting intermediate magnesium-vanadium compound was identified as the probable cause of increased deposits when mag-

1960 ASME WINTER ANNUAL MEETING

"Heat Rate Isn't Everything." James H. Harlow, Chief Mechanical Engineer, Philadelphia Electric, spoke at the Fuels Luncheon.



Invitation to INCO. At the Research Laboratories in Bayonne, N. J., visiting engineers saw how International Nickel studies nickel alloys.

Willis F. Thompson, Fellow ASME, reports to the Business Meeting on progress at the United Engineering Center

Members and Students Luncheon. **Center:** Mr. and Mrs. Theodore C. Kuchler, Jr. Mr. Kuchler received the Undergraduate Student Award for his paper, "Reliability, A New Tool for Design." **Left,** Harold A. Bolz, Ohio State University. **Right,** Glenn B. Warren, Past-President, ASME.

Mr. and Mrs. George M. Dick. He is president of the Engineering Institute of Canada—he is also Mem. ASME.

Meeting of the minds. Technical Sessions offer the presentation of papers, plus the opportunity for discussion.

By the numbers: Organizing the stacks of the 406 technical papers that formed the basic raison d'être for the Meeting.

Another group at the Members and Students Luncheon. **Left to right:** Mr. and Mrs. George N. Hatsopoulos—he was winner of the Pi Tau Sigma Gold Medal Award; David S. Clark, president, Pi Tau Sigma, Ascher H. Shapiro, winner of the Richards Memorial Award; and William H. Byrne, President of ASME.

nesium is used in heavy fuel oil as an additive for preventing vanadium corrosion. Spraying slurry mixtures of water and dolomite, water and lime, water and magnesium oxide, as well as water mixtures with different ratios of calcium and magnesium oxides helped minimize corrosion and deposits in oil-fired boilers by raising the melting point of oil ash.

In work with materials, promising results have been shown for a 60 Cr-40 Ni alloy in resisting the corrosive effects of residual-fuel-oil ash environments.

Power Test Codes. Papers on efficiency determination, polytropic analysis, and gas and fluid dynamics were presented by the Power Test Codes Committee. The effect of measurement errors was considered in relation to efficiency determination and input-output methods were compared with heat-loss methods. The purpose of the polytropic-analysis paper was to derive real-gas equations in place of the less accurate perfect-gas relations frequently used for design and test evaluation of centrifugal compressors. The recognition and application of the common bonds which exist between isentropic, adiabatic, and diabatic flows as well as the normal shock process were sought in a generalized approach to one-dimensional gas dynamics. The concepts of continuity and critical state were combined in a single function. Similar procedures were applied to the constant-density flow problem.

Boiler Feedwater Studies. Chemical cleaning was the topic of a majority of the papers presented in the sessions sponsored by the Boiler Feedwater Studies Research Committee. Some of the conclusions follow. While new chemical-cleaning concepts will some day make it possible to clean boilers while fired and without corrosion damage, inclusion of a cleaning system for preboiler equipment is economically advantageous at present. The practicability of acid cleaning of nonventable and pendant-type superheaters has been demonstrated, but flow rates must be determined. Citric acid requires different precautions than HCl techniques when used for preoperational millscale removal or operational-deposit removal. Ammoniated citric-acid solutions have shown no ferrous acid citrate precipitation and there is lower inherent corrosion of bare metal. Steam washing of powerplant boilers to control silica deposition in high-pressure turbines is effective but uneconomical for most power stations.

Both steel and stainless steel have been used for tubing to simplify corrosion protection, which is almost impossible where both copper and steel are used in the system. Unbelievably clean conditions were obtained with steel and the stainless showed better heat transfer.

Gas Turbine Power. The program for the Gas Turbine Power Division contained 11 outstanding papers on the development and theory of transonic and supersonic compressors. The three sessions at which these papers were presented were jointly sponsored with the Hydraulic and Aviation Divisions. Another session was cosponsored by the Instruments and Regulators Division. Much of the work done on transonic and supersonic compressors has been classified and, therefore, a great deal of this information has never been reported in the unclassified technical literature.

In addition to the compressor papers, there were several papers on unique types of combustion engines including the rotating combustion engine, the rotating-nozzle turbine, and the multicylinder turbojet.

Papers were also given on marine gas turbines, design criteria for matching turbomachinery, and stress analysis of a radial rotor.

Oil and Gas Power. OGP, preparing for its own Conference and Exhibit at New Orleans in April, sponsored only one session. This had an international flavor with two papers from abroad. One by M. E. Barthalon, Assoc. Mem. ASME, chief engineer of SIGMA, Paris, France, dealt with the design and operation of a 25,000-kw free-piston-engine power station. The other by Soren Hansen, chief design engineer, Burmeister and Wains, Copenhagen, Denmark, discussed conversion factors to be used for changed atmospheric conditions in determining horsepower capability.

Other papers concerned supercharging a large two-cycle, loop-scavenged engine and continuing research on charge stratification of spark-ignition engines.

Basic Engineering

Applied Mechanics. The majority of the papers presented by the Applied Mechanics Division were in the field which may be generally described as that of the mechanics of solids, including elasticity, plasticity, thermal stresses, and vibrations. The Division, together with its volume of the Transactions of ASME, the *Journal of Applied Mechanics*, has acquired world-wide renown in those fields. This has happened at the expense of a drastic contraction in the remaining fields which traditionally and appropriately belong: Fluid mechanics, thermodynamics, and boundary-layer theory. These were represented only by three papers in lubrication theory, and one each in boundary-layer theory, thermodynamics, and heat and mass transfer.

A recent report prepared by the Division's Activities Committee emphasizes that activities have become more and more specialized. The percentage of papers in solid mechanics rose from 46 per cent in 1937–1939 to 82 per cent in 1957–1959. There has also been a trend toward the more academic type of paper.

A discussion of whether to accept this situation or to attempt to change it, and on possible ways of changing it, was planned during the 1960 Winter Annual Meeting. The results of this discussion are not available as yet.

Altogether, the Division offered 37 papers at the Meeting, and held one session in which six investigators reported on progress made by the Research Committee on Random Vibration.

Heat Transfer. With the new technologies—among them nuclear power, rockets, and space travel—the men who engineer the transfer of heat have come into their own. The future success of all such projects depends on these men, and the activities of ASME's Heat Transfer Division reflect the new importance of heat calculations ("approximations" might often be a better word; the heat-transfer engineer is faced with such a terrifying array of variables and uncertainties, such a series of assumptions, that he must simplify—and sometimes oversimplify—his calculations). With each year's advance, with every new set of technical papers, the calculations come a little closer to reality, more meaningful in the engineering that will usher in the miracles of the next two decades.

At the Winter Annual Meeting, the Division held what amounted to a continuing symposium on "Theory and Fundamental Research in Heat Transfer." Four sessions were taken up by this subject, with speakers from Chalmers University of Technology of Goteborg, Sweden; Woods Hole Oceanographic Institute, Woods Hole, Mass.; the Royal Aircraft Establishment, Farnborough, England; Technische Hochschule, Aachen, Germany; Cornell University; University of Illinois; Caltech at Pasadena, Calif.; M.I.T.; Commonwealth Scientific & Industrial Research Organization, Victoria, Australia; Harvard University; Brown University; and the University of Minnesota. Such is the world-wide need for understanding of heat transfer.

Other sessions—presentations of technical papers—covered convection, forced convection, boundary layers, radiation, change-of-phase, conduction, and biotechnology.

Lubrication. Less than six weeks prior to the Winter Annual Meeting, the Lubrication Division had participated in the Joint ASME-ASLE Lubrication Conference in Boston. At the Winter Annual Meeting, lubrication papers were largely those of the Research Committee on Lubrication. There has been an increased offering of papers concerned with hydrodynamic and hydrostatic air bearings. Another field which has been expanded is the analysis of thin-film lubrication in such mechanisms as rolling-element bearings and gears.

The one technical session devoted entirely to the Lubrication Division heard a series of reports. There was a review of the ASME-ASLE 1960 Lubrication Conference, and a review of the 1960 ASME Spring Lubrication Symposium. Two reports provided digests of recent literature. There were also papers on boundary lubrication, metalworking lubrication, automotive lubricants, gear lubrication, properties of lubricants, fluid-film bearings, and a survey of the literature on rolling-element bearings.

A new publication, "Lubrication Division Proceedings," began this year. The Division will publish the results of informal transactions at Research Committee Meetings on a continuing basis. Copies of the first Proceedings issued are expected to be available for sale this year.

Metals Engineering. Exotic is the word for some of the materials that must now be taken with utmost seriousness by the makers of machinery. Among the papers offered by the Metals Engineering Division at the Meeting were: "The Fabrication of Thin-Wall Molybdenum Shapes by Welding," and "Effect of Combined Stress on Yield and Fracture Behavior of Zircaloy-2." These papers serve to indicate the extent of the effort directed toward the efficient use of material in severe environments.

The technical activities of members of the Metals Engineering Division fall into three major categories: Improvement in and understanding of metalworking processes and fabrication; advancing knowledge of presently used materials; and development of new materials and applications.

Among presently used materials, interest continues high in the austenitic stainless steels, and in new applications of carbon steels. Example: "Tensile Properties of AISI Types 304 and 347 Stainless Steels at Moderate Temperatures for Section Sizes Ranging From Bars to Extremely Large Forgings." The range of interest in the Division is further shown by a paper which employs model analysis to correlate maximum load data on slotted sheets and plates. Continuing interest in plasticity led to "Experimental Investigation of Corners in the Yield Surface."

Instruments and Regulators. If you design instruments and regulators, you must eventually serve nearly every other engineering discipline. This fact was pointed up at the Winter Annual Meeting, when the Instruments and Regulators Division held five sessions, four of them jointly with other divisions. Their one solo session dealt with heat transfer.

With whom were they co-operating so closely? With Aviation (papers on instrumentation); with Human Factors (papers on human locomotion and biomechanical prostheses); with Gas Turbine Power (control of turbines); and with the Research Committee on Mechanical Pressure Elements (pressure elements in instrumentation). If it goes, it needs controls—and probably instrumentation.

Human Factors. It's a fairly new concept, the idea that people are a part of the engineer's problem. How much responsibility for the complex operation of a machine can a man sustain? How quickly can he react? How good a computer is he?

The ASME's Human Factors Group held two technical sessions, one of them jointly with the Human Factors Society. Papers ranged from the biomechanical design of an artificial leg to the location of the center of mass of man (data needed in the design of space vehicles). And how does man's own means of locomotion compare in efficiency with the locomotion of the vehicles he has devised? There was a paper on the evolution of locomotion.

With the Human Factors Society, the Group took up such matters as "the eye as a servo-control mechanism," and a study of cerebral concussion.

Fluid Meters. The Research Committee on Fluid Meters held a technical session in which three papers were presented, advancing the art of flow measurement. One presented a practical technique for using orifices to meter most gases, a technique that can be employed in pipes less than one inch in diameter as well as larger sizes. A gas tracer method, using carbon dioxide as a tracer, was proposed for the measurement of mass flow in both steady and pulsating air streams. One paper discussed flow measurement for accounting purposes, the industrial measurement of gases and liquids using thin-plate orifices.

Hydraulic. In addition to the discrete topics presented in the Hydraulic Division sessions, there were three symposiums. Scale effects on cavitation—the dissimilarities which appear when changing size, velocity, and/or the properties of the fluid—in scaling up model tests to prototype equipment were considered in one. Most of the conclusions were tentative and included a plea for more research with simulated cavitation conditions for a clearer understanding of cavitation itself as well as scale effects.

More than a dozen methods of actually observing what takes place under various flow conditions were demonstrated in a symposium on flow visualization. In his keynote lecture, S. J. Kline, Mem. ASME, professor of mechanical engineering, Stanford University, stated that even with the best-understood flow phenomena, performance cannot be predicted in advance and visual observation is an important prelude to the development of

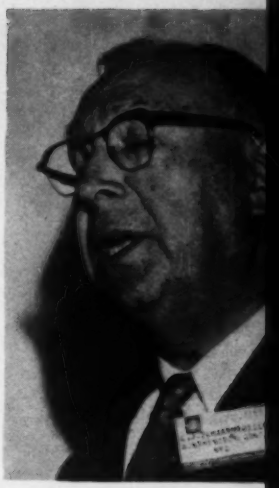
1960 ASME WINTER ANNUAL MEETING

At the Hydraulic Dinner, George L. Mellor, **left,** of Princeton University, receives the Hydraulic Award (a memorial to the late Robert T. Knapp) for his paper on "An Analysis of Axial-Compressor Cascade Aerodynamics." W. C. Osborne of the Division's Executive Committee makes the presentation.

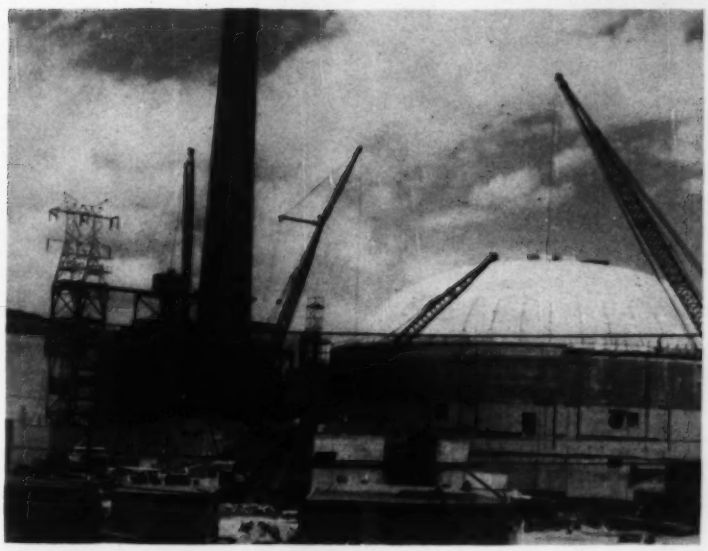
President's Luncheon. On behalf of the Gas Turbine Power Division, J. H. Anderson, Chairman of the Division, hands a $1000 check to President Cisler for the building fund of the United Engineering Center.

"Management as a Profession." At the first Management session, Harold F. Smiddy, vice-president of General Electric, tells the Meeting that "scientific management" is in transition toward "professional management" for the needs of a new age.

Human Factors. Charles W. Radcliffe, University of California at Berkeley, displays a "lower-extremity prosthesis" with a new four-bar-linkage knee mechanism, designed to provide improved stability through the active control of the amputation stump.



E. J. Schwanhausser, Chairman of ASME's Finance Committee, presents his report at the Business Meeting



Consolidated Edison of New York took its visitors through the new Indian Point atomic power plant. The stack is for the oil-fired superheaters used to increase over-all efficiency. The dome covers the nuclear portion of the plant.

The Professional Practice Luncheon. F. E. Lyford, **right**, discusses the work of the Committee on Engineering Laws.

Report from overseas. James H. Lowe, vice-president of the Keokuk Casting Company of Keokuk, Iowa, tells of steel-casting production in Western Europe.

parameter-dependent solutions. For actual design it is necessary to link quantitative numbers to various flow regimes.

Smoke filaments were the clearest and most easily interpreted, while dye injection was cruder but less complicated and expensive. Heat-expandable polystyrene beads, neutral-bouyancy air bubbles, tufts, wall-trace techniques, electrochemical techniques, electric sparks, schlieren methods, shadowgraph systems, streaming birefringence, and interferometry were other techniques that were described.

A manufacturer's symposium on centrifugal and axial compressors dealt with some of the significant advances that have been made in centrifugal-compressor design and some of the design and application problems. It concluded a series which began with the user's viewpoint in 1958 and presented the contractor's and consultant's view in 1959. The operation of modern centrifugal compressors beyond the first and second critical points was compared to the breakthrough in crossing the sonic barrier in aircraft design. Although air compressors are an old story, compression of gases has created altogether new problems. Not only did one rotating assembly actually burn and melt away, but special scaling and corrosion problems are found.

LUNCHEONS AND DINNERS

President's Luncheon

"This past year has been one full of problems.

"Charges that the U. S. A. has suffered a fall in prestige—a fall in technical prestige, a fall in martial prestige, a fall in leadership prestige—have been rampant.

"As President of ASME, Walker L. Cisler has spoken out fearlessly about our technological progress and prestige. It has been a most important contribution he has made.

"What many members of ASME do not realize, however, is the strenuous load he has carried so ably and so self-sacrificingly during these past 12 months.

"The Society's part in the erection of the new United Engineering Center has put many problems on the shoulders of our President. Here, too, he has made significant contributions.

"This is his luncheon and he will speak of his work only as a prelude to his penetrating analysis of what the future holds for the ASME." Thus Toastmaster J. W. Barker, past-president of ASME, introduced President Cisler who gave the major address, "Whither ASME?"

From his keen concern about the broad future of ASME, both on this continent and elsewhere in the world, Mr. Cisler made these observations and recommendations on current facets of ASME's work:

"1 I have great hope for the study that is now being conducted by Cresap, McCormick and Paget, management advisers, who will study our membership, divisions, regions and sections, central staff and voluntary committees, meetings and conferences, and publications. They will work through direct interviews, questionnaires, and a study of records.

"Out of this study, conducted with the advantage of an outside point of view, will come facts, conclusions, and recommendations about ASME that will be most helpful to the Council.

"2 I have been greatly concerned over the difficulty that we are encountering in reaching our goal, through voluntary contributions, for our share in the United Engineering Center. Some sections have had splendid results, exceeding their quotas by half again as much or even more. A greater number of sections has fallen far short of expectations. There is every reason to believe that the best results have been achieved by personal solicitation. I understand that several other societies have already exceeded their quotas, but at present ASME is still about nine per cent short of our share.

"3 For more than a decade we have been aware of the need for closer relationships between the leading engineering societies. Last June, in Dallas, I requested Ronald Smith and Donald Marlowe to meet with similarly designated members of other societies to undertake discussions along lines that showed considerable promise. They have worked most earnestly and I feel that substantial progress has been made.

"4 There is reason for encouragement concerning our international relations, yet I think we will have to work aggressively in this direction to follow up and to expand upon what we have thus far accomplished. There are important engineering societies in Western Europe, South America, the western Pacific area, and in the USSR. Many and indeed all of these need a reaffirmation and expansion of their relationships to us.

"During the year, ASME was represented at important conferences in Brussels and Buenos Aires. The first was EUSEC, the Conference of Engineering Societies of Western Europe, and the second was UPADI, the Pan American Union of Engineering Societies.

"One of the major achievements of EUSEC is a comparative study of engineering education in 19 countries. This

Descriptions of the Honors and Awards and biographical sketches of the men who were honored by the Society at this Annual Meeting will be found in the article, "ASME Honors Engineers," on pp. 106–113 in this issue.

report will be printed in French and in English early in 1961. EUSEC also has made progress toward an international code of ethics for engineers, discussed the appearance of specialized engineering societies, and considered methods by which societies can improve their effectiveness in the field of research.

"UPADI may undertake a comparative study of engineering education in the Western Hemisphere.

"5 ASME is a volunteer society, dependent upon the willingness of members to serve our mutual needs. We can be justly proud of the many men who give generously of their time and ability in these ways. By and large, this decentralization has been effective and we know that the Council guides our affairs with wisdom and foresight.

"As we are now constituted, the President of ASME has little executive responsibility for the effective management of our affairs. Procedural measures growing up over the years have made it traditional that, in effect, the management of ASME is in the hands of committees.

"We would be well advised to ask ourselves whether this is in all respects the most effective organizational structure for so large an association—whether it has kept pace with our growth, with what is happening around us, and with our future needs.

"6 Finally, I recommend that it would be helpful to a President, because of the complexity of the matters that require his attention during a relatively brief term, if he had the assistance of an advisory policy committee made up of the five immediate past-presidents. The need for such a source of counsel may well increase as our Society grows in the years ahead."

As is the custom at the President's Luncheon, the President of the Woman's Auxiliary to the ASME reports on the activities of the Auxiliary. Mrs. Gracer, the re-elected president for 1960–1961, noted that the Auxiliary now has 29 Sections and that the educational-fund activities have taken a lively upturn over the past ten years.

Of the 12 ASME Lecturers for 1959–1960, eight were present and were asked to rise and be recognized by the audience.

The retiring members of The Council were called on to rise and receive the applause of recognition for a job well done. They included: J. W. Little, R. B. Smith, G. R. Hahn, W. F. Ryan, T. J. Dolan, and E. W. Jacobson.

The high point of the President's Luncheon is the presentation of honors—the recognition of outstanding work. Dean H. A. Bolz, Chairman of the Board on Honors, presented the recipients of honors to President Cisler. First he called on William G. Steltz, winner of the Melville Medal for his paper, "The Critical and Two-Phase Flow of Steam." Mr. Steltz presented this paper at the 1959 ASME Annual Meeting in Atlantic City, N. J.; this year he was coauthor with R. P. Benedict of two papers delivered at the Winter Annual Meeting. Gunnar Heskestad and Duane Robert Olberts were the 1960 recipients of the Junior Award for their paper, "Influence of Trailing-Edge Geometry on Hydraulic-Turbine-Blade Vibration Resulting From Vortex Excitation." Unfortunately, Mr. Olberts could not be present at the Luncheon.

Suddenly there was a request from the floor for recognition. Recognition was granted and James H. Anderson, chairman of the Gas Turbine Division, presented to Mr. Cisler in the name of the Division a $1000 pledge to the United Engineering Center Building Fund.

Mr. Cisler also made note of the fact that six of ASME's Professional Divisions were celebrating their fortieth anniversaries: The Aviation, Fuels, Management, Materials Handling, Power, and Railroad Divisions. Their representatives were sitting at designated tables and they were asked to stand to receive congratulations and best wishes.

Machine Design Luncheon

"THERE seem to be two approaches that we can take with respect to the role of applied mechanics in design," said R. E. Peterson, manager of Mechanics Department, Westinghouse Research Laboratories, Pittsburgh, Pa. "One is a broad view of machine design comprising the systems concept—for this activity a broader interdisciplinary type of training is desirable. The other is a more limited concept of design, that corresponding more closely to the mechanical field as delineated by the usual textbooks and courses in machine design. In this area the main need is for increased rationalization as contrasted to design based on rule-of-thumb. In this connection, it is evident that two directions are indicated.

"First, we need the highest type of specialists to develop basic knowledge; and, secondly, we need the type of engineer with broad mechanics training to build from basic knowledge the appropriate methods and models which will be usable in design.

"It may seem that I am suggesting conflicting educational requirements," said Mr. Peterson. "I do not think so."

"The broad-systems people," he added, "can best be trained in the newer curriculums in engineering fundamentals. The top specialists—elasticians, aerodynamicists, experts in heat transfer, dynamics, and so on—are most likely to lay the foundations of their careers in doctorate studies. The engineers who create the more rational design methods are most apt to come from the four-year mechanics curriculums, or from specialists in mechanics at the master's level. These three paths are separate ones leading to different areas, all of which have an important bearing on a broader, stronger, more rational design activity. There is plenty to do for all who have the interest and ability."

The presentation of awards sparked the atmosphere at the Machine Design Luncheon.

Dean H. A. Bolz, chairman of the Board on Honors, introduced F. S. Blackall, jr., past-president of ASME and donor of the Blackall Machine Tool and Gage Award. The recipients, J. Boaz Popper and David W. Pessen, who are presently in Israel, were unable to attend the Meeting. Helmut Pessen of Temple University accepted for his brother and Mr. Popper. They received the Blackall Award for their paper, "The Twinworm Drive—A Self-Locking Worm-Gear Transmission of High Efficiency," presented at the ASME Annual Meeting in Atlantic City, N. J., 1959.

The second award presented—Machine Design Award—was being presented for the second time. The recipient, who was also the principal speaker, was Rudolph E. Peterson. He won the award for eminent achievement and distinguished service in the field of mechanical design; for numerous creative contributions and teaching in research, development, application, and design of machinery to prevent mechanical failure; for outstanding accomplishment in the development of young engineers and scientists, both through his industrial and his university associations.

J. W. Huckert, chairman, Machine Design Division, presided.

Professional Practice Luncheon

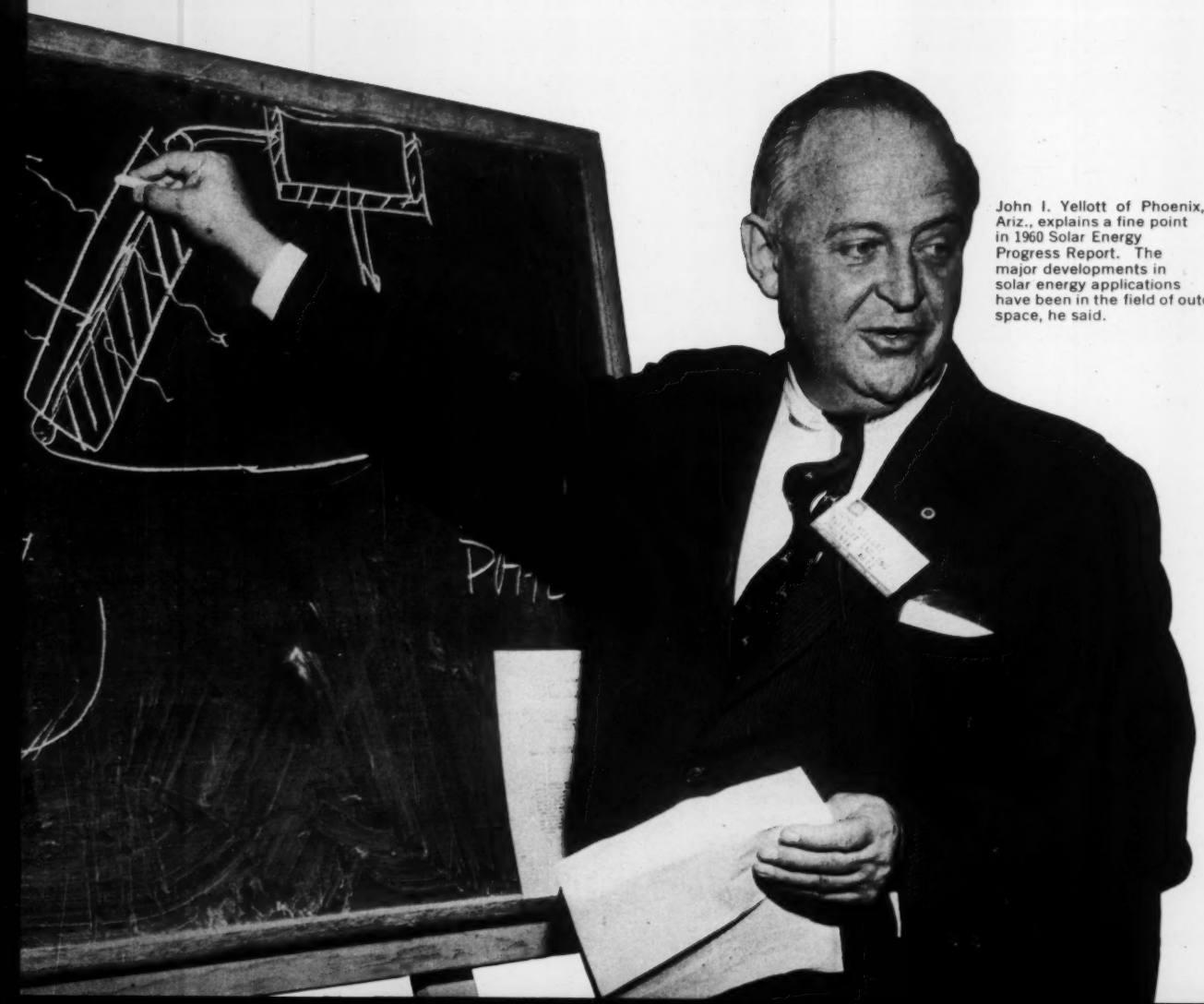
PROBLEMS of the consulting engineer are many. On Tuesday, at the Professional Practice Committee Luncheon, they were discussed in detail. When is an engineer free to practice architecture? And when should an architect be allowed to install his own ventilating systems? What is a good definition of a consulting engineer?

And on to the legal side of things, just

1960 ASME WINTER ANNUAL MEETING

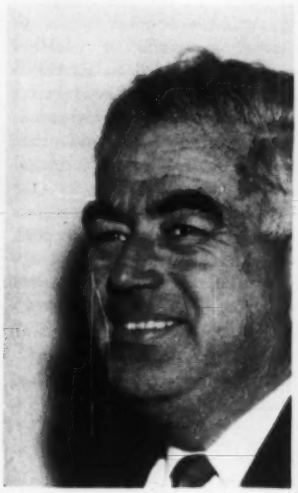
Hugh A. Bogle, **left,** chairman, Management Division, presents $1000 check to President Cisler for UEC building fund at Management Luncheon

William G. Steltz, **left,** receives the Melville Medal for his paper, "The Critical and Two-Phase Flow of Steam," at the President's Luncheon, from Dean H. A. Bolz, chairman, Board on Honors. Mrs. Steltz looks on.



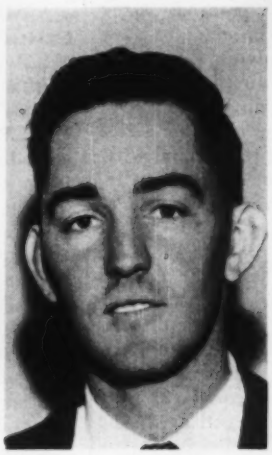
John I. Yellott of Phoenix, Ariz., explains a fine point in 1960 Solar Energy Progress Report. The major developments in solar energy applications have been in the field of outer space, he said.

Arthur Kantrowitz, vice-president and director, Avco Corporation, speaks on research frontiers in fluid mechanics at Hydraulic Dinner



Prof. Myron Tribus presents a light review of convection from Newton to the present at Heat Transfer Luncheon

John W. McDaniel of The Trane Company receives the Charles T. Main Award at the Members and Students Luncheon



Joseph W. Lindsey, University of Utah, delivers his paper at Members and Students Luncheon. This paper won for him the Old Guard Prize.

Visitors who inspected the Grumman plant saw several types of carrier-based aircraft in various stages of assembly. They also got a firsthand glimpse of parts and plane sections.

Design and status reports on large power reactors are discussed at Nuclear Engineering Power Session

what is the Committee on Engineering Laws? There really was an answer to that question. They all leaned forward to hear the official explanation of the committee's development and purpose from its executive director, Frederick E. Lyford. And so it went—two tables in the round, each with its own absorbing discussions, which ran on into the Professional Practice Committee Meeting in the afternoon.

Heat Transfer Luncheon

The Heat Transfer Luncheon, held Tuesday, November 29, featured a lively address by Prof. Myron Tribus of UCLA on ancient and modern studies in heat transfer, and a plea by a member of another Division for closer contact between the two Divisions.

Dr. Stephen I. Juhasz of Southwest Research Institute, and Executive Editor of *Applied Mechanics Reviews*, urged the heat-transfer specialists to subscribe to *Applied Mechanics Reviews* as well as to their own *Journal of Heat Transfer* because it contains so much heat-transfer material. There is a wide overlap in the studies of heat transfer and applied mechanics, and it is inevitable that the two journals contain material essential to both disciplines.

Prof. H. A. Johnson of the University of California in Berkeley presided as chairman of the Heat Transfer Division. To past-chairman W. E. Hammond of Air Preheater Corporation went a certificate in recognition of his five years of service on the Executive Committee of the Division.

Prof. Tribus covered, briefly and gaily, 2000 years of heat-transfer theory and experiments. Philo . . then Galileo and Newton. After that, the picture began to change more rapidly, and with the work of Prandtl in 1921, entered a truly modern era. Prof. Tribus spoke of a few of the men working today, such as Hartmann, Eckert, Dusinberre, Paschkis, Frossling.

One of the biggest problems facing any heat-transfer experimenter is to know how to go about solving a problem. Few can be solved directly, as there are always an unlimited number of variables. An engineer must first decide what to assume, what to simplify, what to ignore, what to solve for—and finally, how to go about it. When he is through, he can only hope that his answer has some relation to his problem and some usefulness—that it wasn't simplified out of all relation to reality.

Gradually, inch by inch, the theories are being checked against the experimental results, experimental results against reality; new theories are being evolved and old ones changed and checked again. Theory and reality are coming closer together each year.

Fuels Luncheon

James H. Harlow, Fellow ASME, chief mechanical engineer, Philadelphia Electric Company, spoke at the Fuels Luncheon on the topic, "Heat Rate Isn't Everything." Acknowledging that more efficient coal production has had a major part in keeping the cost of electricity stable while nearly everything else has risen, he outlined some of the improvements in metals, chemistry, controls, and better thermal devices that have contributed to increased efficiency.

A pound of coal now produces twice as much electricity as it did before the war. At Eddystone, about 0.6 lb of coal produces 1 kwhr of electricity. This 5000-psi 1200/1050/1050-F plant is probably the maximum improvement in heat rate that can be economically justified at present.

However, there are other roads to decreased cost. A study of whether equipment is being loaded to its maximum capability can be most productive. How much can a boiler be overloaded, for example, before slagging and other unfavorable conditions became unbearable?

The use of less costly equipment, but also less efficient equipment, for peak shaving was another recommended approach, as well as pumped storage for hydro generation.

William T. Reid, ASME Fuels Division chairman, Assistant Technical Director, Battelle Memorial Institute, presided at the Fuels Luncheon.

Applied Mechanics Dinner

At the Applied Mechanics Dinner, held Tuesday, November 29, in the Men's Faculty Club at Columbia University, Dr. William Prager of Brown University stood as toastmaster in place of S. B. Batdorf, chairman of the Applied Mechanics Division, who was unable to attend.

Dr. Prager spoke of the trend toward specialization within the Division, notably toward emphasis on theoretical dynamics, elasticity, and plasticity. He decried this trend toward narrow fields of activity and called on the Division to increase the representation of the less active specialties. He also noted a decline in the number of technical sessions—though he added that the *Journal of Applied Mechanics* leads the other Transactions journals with a total of 6800 subscribers.

Dr. J. P. Den Hartog of M.I.T. gave the background of the Timoshenko Medal which was established in 1957 to be conferred annually in recognition of distinguished contributions to applied mechanics. It was instituted by the Division to honor Stephen P. Timoshenko, world-famed authority in the field. The award this year went to Dr. Cornelius B. Biezeno of Technological University, Delft, Holland, and to Dr. Richard Grammel of Stuttgart Institute of Technology, Stuttgart, Germany, for their monumental work, "Technical Dynamics."

Neither recipient could be present. O. B. Schier, II, Secretary of ASME, presented the medal to Dr. Den Hartog for Dr. Biezeno, and to Prof. Eric

Reissner of M.I.T. for Dr. Grammel. In both cases, messages from the recipients were read.

The Worcester Reed Warner Medal went to Dr. L. M. Donnell, Research Professor at the Illinois Institute of Technology. The medal was established in 1930 by bequest of Worcester Reed Warner, Charter Member and 16th President of ASME. This 1960 award was made to Dr. Donnell for "outstanding contributions to the permanent engineering literature . . . his many papers in the field of applied mechanics ranging from the theory of buckling of thin shells, to the development of new methods for testing aircraft structures, and his role in establishing *Applied Mechanics Reviews*."

Mr. Schier presented the medal to Dr. Donnell, "A bronze one for the desk, a gold one for safekeeping."

Management Luncheon and Towne Lecture

The Towne Lecture, given this year by Col. Lyndall F. Urwick of London, England, was the feature of the Management Luncheon, held on Wednesday, Nov. 30. The Lecture is in honor of Henry Robinson Towne, President of ASME in 1889, whose paper in 1886 on "The Engineer as an Economist" initiated the flow of valuable Society contributions on scientific management. First given by Herbert Hoover in 1925, the Towne Lecture offers opportunity for an outstanding leader in the field of management, economics, or business to reveal his experience, preferably related to the scientific method in industry or business.

At the luncheon, Hugh A. Bogle, chairman of the Management Division, presented a check for $1000 to Walker L. Cisler, ASME's outgoing President, for the building fund of the United Engineering Center. Later, Mr. Cisler presented a certificate of Fellow ASME to James P. Stewart, president of De Laval Steam Turbine Company. Mr. Bogle also was honored: He received a gavel in token of his years of work on the Executive Committee of the Division.

Colonel Urwick, the first British subject to have the honor of delivering the Towne Lecture, spoke on "The Engineer's Debt to Management." His speech will appear as a feature article in a future issue of MECHANICAL ENGINEERING. In the speech, he made the point that ASME was "the cradle of management knowledge in this country," due mainly to the pioneering of Mr. Towne, who was president of the Yale Lock Company, later Yale and Towne Manufacturing Company. Mr. Towne's 1886 paper initiated this line of study.

Metals Engineering Luncheon

T. J. Dolan, ASME Vice-President of Region VI, spoke on "Our Profession and Your Society" at the Metals Engineering Luncheon. Defining engineering as the profession in which broad general knowledge in the sciences is applied with judgment and the use of materials and energy for the welfare of mankind, he emphasized "judgment" and the "welfare of mankind" in his speech.

In the increasingly competitive world in which lower-labor-cost nations are now adding automation and other production-increasing devices, he stated that we need to take a look at some of the other aspects of our products. Reliability is important as well as volume, and engineers should re-examine their code of ethics to see if there has not been some disregard of the "welfare of mankind" in this respect. He cited automobile production, in particular, where a major breakdown can be expected within 1000 hr, and style and status appeal govern design.

ASME's provision of a forum for an interchange of ideas and facilitation of communication where technical publication is becoming almost overwhelming can be a major contribution to the struggle to stay ahead competitively, he stated.

William L. Cooper, ASME Metals Engineering Division Chairman, of the General Electric Company's Knolls Atomic Power Laboratory, presided.

Hydraulic Dinner

The "Research Frontier in Fluid Mechanics" was the topic of the Hydraulic Dinner address by Arthur Kantrowitz, vice-president of the Avco Corporation. Dr. Kantrowitz stated that he would not attempt an exhaustive catalog of the limits of hydraulic knowledge, but would outline the areas in which he was most interested which also happened to be frontiers. He prefaced his remarks by calling attention to the role of application in determining the type of basic research that is done.

Prandtl didn't do his work until there was an airplane that needed it desperately, he stated. Similarly, the reason that the fundamentals of turbulent flow have not been solved mathematically may be that they have not been needed desperately enough.

The great advances in ballistic missiles and space vehicles have produced problems with appreciable amounts of stagnation, radiation, and so forth. Derivative from the solution to one of these problems is the magnetohydrodynamic generator. It started with studies of the flow of gases and the idea that something could be done in the field of power generation if the gases were "seeded."

Now it seems possible that MHD may take over the generation of power. There are competitors, of course, but MHD seems the best of the group, and unless someone is "very brilliant" with the steam cycle it will be impossible for it to compete with MHD. However, "MHD is far from a *fait accompli*." (In response to questions, he set Jan. 1, 1970, as the date for its accomplishment.)

In spite of the problems, Dr. Kantrowitz said, the gas used is not too different from the acetylene used for years in welding applications. The electric current flows off at an angle, rather than in the direction to be expected, but those familiar with crystal reactions would not find that too different. In many crystals when force is applied, the reaction is a predictable vector rather than a parallel or perpendicular phenomenon.

Electrodes are needed, and heat-transfer apparatus that works at higher temperatures before MHD can become a reality.

The nuclear fusion reactor, he termed "a kind of left end" of fluid dynamics, requiring temperatures of 100 million K, where gases are no longer familiar objects. Devices designed for 10,000 K don't work at all at 2 or 3 million K. The dissipative phenomena just are not understood. A sort of molecular collision seems to be the prime phenomenon. Groups of charged particles act together via their charged condition. When we understand it, it will be time to begin seriously to try to invent a fusion reactor.

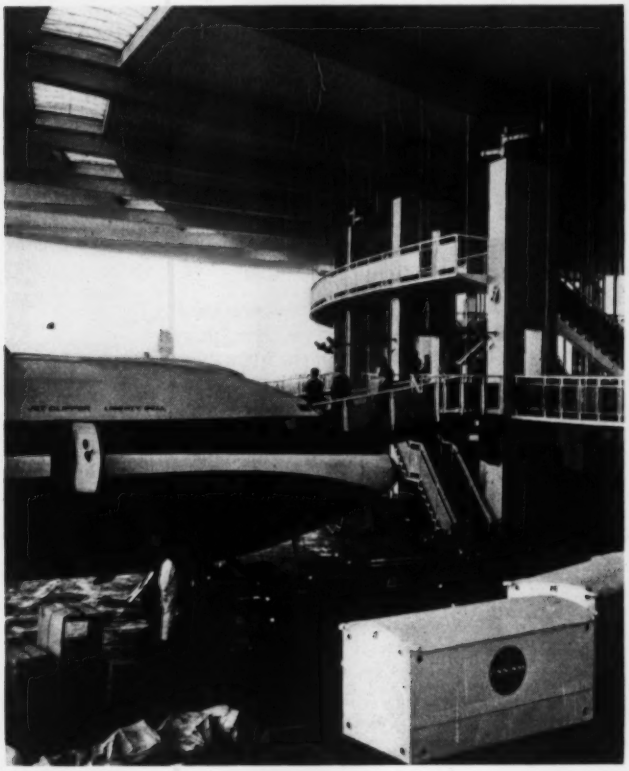
Just as Columbus solved a major obstacle in his path by setting out in a new direction, Dr. Kantrowitz said, setting off in a new direction in research is bound to solve major new problems. In the case of fusion, the solution of the dissipative problems may prove more important than fusion itself.

The second recipient of the Hydraulic Division award established last year as a memorial to the late Robert T. Knapp was made to George L. Mellor, Assoc. Mem. ASME, assistant professor in the School of Engineering, Princeton University, for his paper on "An Analysis of Axial-Compressor Cascade Aerodynamics." W. C. Osborne, Mem. ASME,

1960 ASME WINTER ANNUAL MEETING

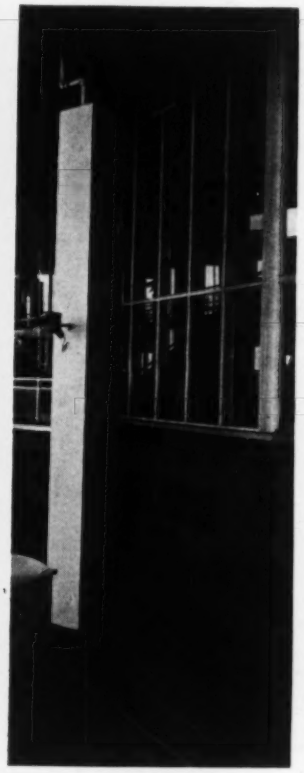
J. D. Quinn of du Pont discusses recording equipment that provides information on machine down time

Pan American Airlines Terminal at New York International Airport provided an ASME inspection group with a glimpse of modern passenger handling



1960 Towne Lecturer Lyndall F. Urwick, **right,** receives special certificate from Hugh Bogle, **left,** as Dr. Gilbreth smiles approvingly. Occasion was the Management Luncheon.

R. B. Lea, **left,** and Incoming President Byrne, **right,** discuss international engineering education with Prof. M. V. Kamlani, University of Roorkee, Roorkee, India



This case is heavy! Must be all those technical papers I bought.

Serious Business. At the full Council Meeting, Incoming President Byrne, **left,** President Cisler, **center,** and Secretary Schier listen intently as someone makes point from floor.

Optimizing a regenerative steam turbine cycle: A new method developed at Edison-Volta, S. p. A., of Milan, Italy, is presented by Dean J. H. Potter at a Power Session

and a member of the Division's Executive Committee, made the presentation.

Division Chairman Howard W. Emmons, Mem. ASME, professor of mechanical engineering at Harvard, was toastmaster.

Members and Students Luncheon

This is the event that counts—it is a little like the Navy "parading the fleet"—for it is at this luncheon that first big steps from student to member grade accomplishments are recognized and honored.

Prof. Carl J. Eckhardt of the University of Texas gave the Invocation at the opening of the luncheon, and Past-President G. B. Warren presided.

Mr. Warren introduced distinguished visitors attending the meeting including Prof. M. W. Kamlani, Head, Department of Mechanical Engineering, University of Roorkee, Roorkee, India. He also introduced the wives of recipients of awards present at the luncheon; namely Mrs. G. N. Hatsopoulous, Mrs. T. C. Kuchler, Jr., and Mrs. J. L. Lindsey.

Then Mr. Warren spoke briefly on the definition of mechanical engineering and what mechanical engineers do.

Prof. David S. Clark of Purdue University, president of Pi Tau Sigma, made a few salient remarks about the honorary fraternity he represents—that Pi Tau Sigma was established in 1915 and today has 70 chapters and more than 30,000 members. He then presented George N. Hatsopoulous for the Pi Tau Sigma Gold Medal Award conferred for outstanding achievement within ten years after graduation from college and Prof. Ascher H. Shapiro for the Richards Memorial Award for significant achievement within 25 years after graduation from college.

Dean H. A. Bolz, as chairman of the ASME Board on Honors, presented the recipients of honors and awards. Mr. Warren read the citations and W. H. Byrne, incoming President of ASME, conferred the awards. Theodore C. Kuchler, Jr., received the Undergraduate Student Award; John W. McDaniel, the Charles T. Main Award; and Marc Fishzohn, the Arthur L. Williston Award.

Joseph W. Lindsey of the University of Utah won the Old Guard Prize for his paper, "A Cold Flow Study of Nozzle Feeding in a Four-Nozzle Rocket Case," which he had presented at the Old Guard Prize Contest held during the ASME Summer Annual Meeting in Dallas, Texas, June 8, 1960. The Old Guard was called on to rise and receive the applause of the audience. Mr. Lindsey's paper will appear in a forthcoming issue of MECHANICAL ENGINEERING.

Annual Banquet

THE Annual Banquet is more than glittering panoply and sparkle—it is the end of a meeting, an administration, and the beginning of a new year with a new president, the prospect of a new center for engineers, and new worlds to conquer. However, one old flavor remains, year in and year out, it is the time when great achievements in engineering bring honor to those who have done the work.

"This annual banquet is the dramatic climax of the 81st Winter Annual Meeting of The American Society of Mechanical Engineers," said W. L. Cisler, Toastmaster and out-going ASME President. "Advances in engineering have been discussed in papers presented by 617 authors in 406 papers, grouped in 122 technical sessions. Examples of these advances have been exhibited in the National Exposition of Power and Mechanical Engineering, sponsored by ASME, and held in the New York Coliseum concurrently with this meeting."

Mr. Cisler introduced the ladies seated at the dais and H. H. Johnson, the chairman of the General Arrangement and Banquet Committee for the Winter Annual Meeting. The introduction of distinguished guests continued as O. B. Schier, II, Secretary, ASME, read the names of the guests representing many of the societies and organizations with which ASME co-operates closely.

Mr. Cisler also asked the 50-year members present to rise and be recognized.

Old Guard. The Old Guard, composed of those having 35 or more years of membership, have continued their program of professional development of Students and younger members of the Society.

Under the leadership of Walter Betts and Richard North, the Old Guard again arranged for the winners from each of the 12 Regional Student Conferences to meet at the ASME Summer Annual Meeting in Dallas, Texas, and compete for a single national Old Guard Prize. The winner presented his paper at the Members and Students Luncheon and was at the banquet as a guest of the Old Guard. He is J. W. Lindsey.

Mr. Cisler asked the Old Guard to rise so that the guests "may see the men who are helping our students and younger members."

New Council Members. Mr. Cisler introduced the new members of the Council. They are: Two Directors, J. B. Jones and R. S. Stover; and five Vice-Presidents, Eaton H. Draper, Harold Grasse, Allen H. Jensen, Roy C. Robertson, and George B. Thom. (See MECHANICAL ENGINEERING, August, 1960, pp. 122–127.)

The President. The retiring president introduced William H. Byrne, 80th President of the Society, who was greeted with a standing round of applause.

In his brief address, Mr. Byrne expressed his gratitude for the honor of having been elected President of the Society and said, "The coming years will see even greater reliance by all mankind on the skills of the engineer. Our engineering profession has a great role to play in the future welfare, development, and preservation of our world whether it be for military defense, economic growth or our country, economic growth of undeveloped nations of the world, the race

for the conquest of space, foreign competition, or just our way of living. All of these are basically engineering problems.

"Our engineering profession, therefore, must plan to meet the technological challenge of other nations by maintaining its professional leadership through its contributions to the engineering needs of all mankind. This," said Mr. Byrne, "if it is to be accomplished successfully, requires strong engineering societies.

"In these Societies," he pointed out, "the leaders and educators of the profession congregate. It is these societies which must continue to set the example and lead the way for the future development of the engineering profession.

"If we accept this to be a fact, then we, the membership, have a fundamental responsibility to maintain a strong and healthy ASME. Our progress will be in direct ration to the strength and quality of our membership.

"With more members participating," he concluded, "We will not only get more specific jobs done, we will not only develop a greater pool of leaders for our society activities at all levels, we will not only serve membership better, but the over-all result will be a stronger society, in which we can all share pride in its prestige and its contribution to the profession and our own individual status as engineers." Mr. Byrne then presented Mr. Cisler with the Past-President's Pin.

Honors. Mr. Cisler continued in his role of Toastmaster to the bestowal of honors.

"The recognition of an engineer's work by his fellow engineers is his greatest reward for accomplishment," said Mr. Cisler. "This Society is proud of the honors it bestows and welcomes this opportunity to confer some of them before such a distinguished audience."

Dean Bolz presented Carl Richard Soderberg for the ASME Medal and Henry Townley Heald for Honorary Membership in the Society. Both of the honorees were greeted by a rising ovation.

Mr. Cisler then introduced the speaker of the evening, Canon Laurence H. Hall, Senior Canon in charge of Trinity Episcopal Cathedral in Cleveland, Ohio, who gave an amusing witty talk on "Humor, a Catalyst to Creative Thinking."

The banquet had been formally opened with the Invocation given by Prof. Carl J. Eckhardt of the University of Texas, Austin, Texas.

INSPECTION TRIPS

New York is a building city, and the scientific and industrial areas around it are also building, as many ASME members discovered when they took time out to join one of the five inspection tours offered during the week.

Indian Point. At Indian Point, 35 miles north of Times Square, the Consolidated Edison Company of New York, Inc., is building a $100 million nuclear electric generating station. Major construction started in 1958. The plant, scheduled for completion in 1961, drew 100 ASME visitors on Tuesday. They viewed the huge concrete cylinder and dome that house the reactor and boiler sections, and learned that two men in a console unit could operate the entire reactor. Several visiting engineers came away excitedly quoting statistics that included the diameter of the concrete sphere (160 ft), the average thickness of the external cylinder ($5^1/_2$ ft), and the 275,000 kw of electricity the plant will be capable of developing.

Bayonne Research Laboratory. At the International Nickel Company, Inc., in Bayonne, N. J., ASME members saw several new machines and test devices for researching the properties and applications of nickel and its alloys. Dr. W. A. Wesley, manager of the research laboratory, prefixed the Tuesday tour with an explanation of some of the research projects, which include the study of nickel as an alloying material in steel, and the resulting resistance to corrosion.

New York International Airport. The terminal city at Idlewild, with its streamlined, floating shapes, some still going up, provided another look at the futuristic present on Wednesday. Women expressed more interest in this tour, and particularly in the way entire meals were frozen for future flights. The group saw the $16 million Pan American World Airway's hangar, in which several jet airliners were being overhauled. Later, after viewing the airport's colorful central heating and refrigeration plant from ground level, and its huge expanse of acreage from an eleventh-story observation deck, the group returned to the city, minus two of its number who decided to stay and see more.

Model C Stellarator Laboratory. Princeton University's new laboratory buildings, constructed for Project Matterhorn, were toured on Wednesday by a band of scientists and engineers from the ASME Annual Meeting. They observed the Model C Stellarator being assembled for the study of hot, ionized gases. As explained by N. W. Mather, professor of electrical engineering at Princeton, externally produced magnetic fields are used to confine a plasma of hydrogenic ions and electrons while it is heated and maintained at temperatures high enough to produce fusion reactions. With this facility, he explained, scientists hope to discover the conditions for controlled production of thermonuclear reactions.

Grumman Aircraft. Grumman Aircraft Engineering Corporation at Bethpage, L. I., showed off its brand new Avionics building to a tour group on Thursday. The building, which is specially grounded, embodies numerous other safeguards for testing the sensitive electronic equipment used in all company aircraft. Men from a number of company projects, among them John Coutinho, Mem. ASME, chief of reliability control, and George Klaus, manager of the Avionics system center, guided the group through the complicated facilities. The visitors also passed down the corporation's assembly line, watching several types of aircraft take shape in production.

College Reunions

Change, change, nothing but change—the best way to catch up with the "doings" is at a college reunion. During the Winter Annual Meeting, on November 30, 15 reunions were held.

Whether at luncheon, dinner, or at the local schools, from all reports, each one was well attended.

The success of these events is due largely to the interest of the alumni of the following schools: Brown University, University of California, College of the City of New York, The Cooper Union, Cornell University, University of Michigan, University of Missouri, University of North Dakota, The Ohio State University, Pratt Institute, Purdue University, Rensselaer Polytechnic Institute, Stevens Institute of Technology, Tufts College, and Worcester Polytechnic Institute.

Committees in Charge

ASME Meetings come under the supervision of the Meetings Committee.

The technical program is provided by the Society's professional divisions and technical committees. Other features are planned and supervised by committees organized within the host section—in this case, the ASME Metropolitan Section.

In grateful acknowledgment, the many committees, whose efforts contributed so substantially to the success of the 1960 Winter Annual Meeting, follows:

ASME Meetings Committee: W. Burdette Wilkins, *Chairman;* Lester C. Smith; Kenneth L. Selby; T. S. Fetter, Jr.; C. A. Jurgensen; Albert S. Gold stein; E. F. Hoelscher.

Board on Honors: H. Drake Harkins, *Chairman;* E. G. Bailey; Harold A. Bolz; Jerome C. Hunsaker; Arthur M. Perrin; Lewis K. Sillcox; Robert C. Spencer, Jr.

Medals Committee: Robert C. Spencer, Jr., *Chairman;* Henry B. Atherton; Henry M. Black; Richard B. Engdahl; Vivian F. Estcourt; Herbert Estrada; Alfred J. Ferretti; George F. Habach; Ferris T. Harrington; George T. Hayes; Linn Helander; Miklos Hetényi; Theodore C. Heyward, Jr.; Oscar J. Horger; Jacob A. Keeth; William T. Martin; Stephen D. Moxley; George F. Nordenholt; Herbert B. Nottage; Henry W. Page; William P. Saunier; Charles F. Savage; Kenneth J. Trigger; Dana Young.

Metropolitan Section Executive Committee: Robert E. Abbott, *Chairman;* Justus T. Vollbrecht, *Secretary;* John L. Mazaika, *Treasurer;* Miss Muriel O. England, *Assistant Treasurer;* Frank G. Feely, Jr.; Ernest Hartford; William Kowalsky; Frederick H. Linley, Jr.; Charles T. Oergel; Richard S. Touma; H. H. Johnson, *Ex-Officio.*

Winter Annual Meeting Committees General Arrangements: H. H. Johnson, *Chairman.*

Technical Events: Myron F. Dallen, Jr., *Chairman;* William S. Cameron; Donald S. Morton; Kenneth E. Quier; Daniel L. Rubman.

Plant Trips: Erwin Kirsch, *Chairman;* A. O. Downs, Jr.; Leonard Schoenman; E. J. Sharkey; Clement Strefuss; James Tambini.

Banquet: Herman H. Johnson, *Chairman;* Arthur M. Perrin, *Vice-Chairman,* Edlow S. Bance; Reese W. May; Justus T. Vollbrecht.

Ushers: Robert E. Abbott; Frank L. Bradley, Jr.; William S. Cameron; John de S. Coutinho; Myron F. Dallen, Jr.; John E. Gajarsky; William Kowalsky; R. E. Love; Roger E. Marion; John L. Mazaika; George J. Nicastro; Harry L. Parlette; Herbert F. Roemmele; E. A. Salma; W. A. Vopat; John Weiss; Edward E. Williams.

Ladies Committee: Mrs. T. N. Graser, *Honorary Chairman;* Mrs. Erik Oberg, *General Chairman;* Mrs. John C. Gibb, *Vice-Chairman;* Mrs. William H. Byrne, *Vice-Chairman;* Mrs. William Hausmann, *Chairman,* Metropolitan Section.

BUSINESS MEETING

The Annual Business Meeting of The American Society of Mechanical Engineers convened at 4:45 p.m., Nov. 28, 1960, in the Gold Ballroom of the Statler Hilton Hotel, New York, N. Y. ASME President Walker L. Cisler presided.

ASME Secretary, O. B. Schier, II, presented high lights from the Annual Report of the Council, Boards, and Committees.

Annual Report High Lights. The Annual Report will be issued, stated Mr. Schier, in the same separate form as it has for the past three years:

On Society membership, Mr. Schier reported that, as of Sept. 30, 1960, there were 57,216 members, including 11,000 student members.

In ASME Codes and Standards activities during 1960, the Committee on International Standardization was created and, by Council action on Nov. 27, 1960, was officially written into the By-Laws of the Society. It will henceforth be responsible for the work relating to international standardization and international research work, as ASME deals with the International Standardization Organization and Electrotechnical Commission.

In the fall of 1960 two international meetings, under the auspices of ISO, were held in the United States to initiate work on international standards dealing with machine tools and hand-held tools, respectively. Both of these areas are within ASME sphere of interest. We were proud to welcome our foreign friends.

In the area of publications, Mr. Schier pointed out that Mechanical Engineering during the year 1960, beginning in January, each month had a special report or survey.

A special issue on design engineering was published in May to coincide with the ASME Machine Design Conference and concurrent exhibit at the Coliseum in New York City.

During the year more than 700 technical papers were processed for presentation at meetings.

Also, in this period, the first full year of operation of the Transactions published in five separate journals was completed. As a result of this presentation of the formal papers of the Society, we now have 21,376 subscribers.

This compares to about 5000 that we had the year before for the eight issues of *Transactions* and 6000 for the *Journal of Applied Mechanics*.

The *Applied Mechanics Review* is now in its thirteenth year and is recognized around the world as indispensable for the engineering scientist interested in mechanical arts and science. This year some 3500 copies were distributed of each of the issues.

The Society prepared more than 500,000 individual pamphlet copies of 700 technical papers and maintains a stock of some 300 books, codes, standards, and other publications.

Further, the Society filled orders for about 75,000 copies of these publications and more than 50,000 copies of special publications and the Society's journals.

Special publications which were issued during the year include a translation of the Russian book, "Friction and Wear in Machinery," as well as a continued translation of the Soviet periodical under its English title, "Journal of Applied Mechanics and Mathematics."

Research activities of the Society continued at an accelerated pace. Five ASME research committees provide guidance and advice to research committees sponsored by others, such as research recently completed in a series of investigations by the U. S. Atomic Energy Commission regarding materials for use in nuclear applications.

Concurrently several other research committees carried out six surveys of the state of engineering knowledge in their areas of interest.

Again in the international area, Mr. Schier pointed out that President Cisler attended the meeting of the Conference of Engineering Societies of Western Europe and the United States, held in Brussels, Belgium, in August.

The Society was represented at the Pan-American Union of Engineering Societies, which met in South America late in September.

In the area of education, the ASME Board on Education, in conjunction with the Engineering Institute of Canada, conducted the Fourth Biennial Engineering Education Conference at Montreal, Que., Canada, on the theme, "The Engineer in 2000 A.D.—How Much Science in His Education?" (See MECHANICAL ENGINEERING, December, 1960, pp. 118–120.)

In the area of finances, out of a total income of $2,301,219, we came close to our objective as required by the Constitution of providing this money in turn in the form of services to members and committees. We expended $2,301,219 and put into surplus $385.

United Engineering Center. Willis F. Thompson, Fellow ASME and president, United Engineering Trustees, reported building construction for the UEC was started Dec. 14, 1959, just about a year ago. The cornerstone was set June 16, 1960, and steel was topped out July 26, 1960, on schedule.

At present the building is nearly 50 per cent completed.

The over-all cost of the Center will be about $12,300,000.

Finance Committee. E. J. Schwanhausser, chairman of the Finance Committee, related the responsibility charged to his Committee: That of supervision of the custody and safekeeping of the funds of the Society and the investment of those funds. Another facet of the Committee's responsibility is that of budgeting both the income and the disbursements from income for those items which are controllable.

Mr. Schwanhausser stated further that a general decline of security values in the stock market required considerable investing and reinvesting, molding our policy of investment accordingly in order to keep our proper balances.

The income has gone steadily up. It is now in the area of $80,000 a year. That again is based on the capital costs, accumulated capital value, and it has gone from 2.5 per cent yield in 1951 to approximately $4\frac{1}{2}$ per cent at this time.

Both reports—Council and Finance—make up Section 2 of this issue of MECHANICAL ENGINEERING.

Admissions Committee. Mr. Schier reported that the Society admitted 1158 new members. Since ASME has an active students' program in which graduating student members are automatically promoted into associate member grades, the Society admitted 2850 student members or a total of 4008 members during the current year. Mr. Schier reported further that during the year 285 members died.

Constitutional Amendments. Ralph W. Miller, chairman, Constitution and By-Laws Committee, reported: "There was a constitutional amendment sent out for a membership ballot [regarding] . . . . a change to Article C-7, Section V, which changed the method of procedure in selecting the new President in case there was a vacancy in the office of the Presidency. This ballot closed on Nov. 8, 1960. There were total ballots cast of 14,535. Of this number 14,110 were valid and were in favor, and 309 had opposition votes. Therefore this particular amendment to the Constitution has been passed by the membership."

The Secretary then read the report of the Tellers of Election for 1961–1962 Officers, Frank P. Berganzi, William Kowalsky, and R. S. Touma, and the President called on the newly elected officers rise and be recognized.

The officers elected are: William H. Byrne, President; George B. Thom, Roy C. Robertson, Donald J. Bergman, Eaton H. Draper, and Allen H. Jensen, Vice-Presidents to serve for two years; Harold Grasse, Vice-President to serve for one year; and James B. Jones and Rolland S. Stover, Directors to serve four years.

Biographical sketches of the newly elected officers were published in MECHANICAL ENGINEERING, August, 1960, pp. 122–127.

ASME Member-Gifts Campaign. William Larkin reported, at the present time, ASME stands at 91.2 per cent of its quota. We have approximately $73,000 to go. He mentioned a few high lights, particularly where Region V went over the top with 105.3 per cent, due primarily to the persistence and enthusiasm of Ernest Allardt.

Out of 15 Sections, seven have gone over 100 per cent. Dayton and Cincinnati were particularly outstanding.

The top performance was Waterbury with 180 and Northwest Florida. Northwest Florida has 95.3 per cent membership participation. It shows it can be done.

Unity of the Profession. Ronald B. Smith, chairman, ASME Intersociety Relations Committee, reported that his committee was formally organized in Dallas and was charged at that time with the immediate responsibility of formulating a strategic approach to unity with the engineering profession.

"The general strategy was one of first understanding and agreeing among ourselves," said Mr. Smith, "of exploring with our sister societies to determine their interest and possible support, and of finally recommending to the Council plans for future action."

Mr. Smith stated that agreement has been reached and exploratory discussions have been held with four of the Founder Societies.

So far, the work has been carried forward with other societies on a confidential basis by a small negotiating group.

However, Mr. Smith remarked, on an informal basis at least there appears to be a high degree of mutual understanding among ASME, AIEE, and NSPE, which, if promptly nurtured, can serve not only as an example of unity in practice, but as a milestone in moving toward unity within the profession.

On this hopeful note, President Cisler adjourned the meeting.

1960 ASME POWER AND MECHANICAL ENGINEERING SHOW

THE 24th National Exposition of Power and Mechanical Engineering took place at the Coliseum in New York, N. Y., November 28–December 2, 1960, concurrently with ASME's Winter Annual Meeting.

An advance description of the Power Show appeared in MECHANICAL ENGINEERING for November, 1960, pp. 141–148. Some 200 exhibitors, including leaders in all fields of manufacturing, engineering, and research having to do with the generation, transmission, measurement, and use of power, stood by to meet and confer with the visiting engineers. There were displays of developments in raw and fabricated materials, component parts, motors, pumps, blowers, and a wide variety of controlling devices and instruments, including advances in automation. Many "live" exhibits showed actual or simulated performance.

The general public was not admitted. If you wore the badge of ASME's Winter Annual Meeting, that became your admission card. The Society had its own booth, presenting a number of the more than 350 publications which are among its most important contributions to the profession.

On these pages are photos of the show, with a few of the engineers (total count, more than 20,000) who strolled the aisles and made contact with exhibitors. The show was sponsored by ASME, and was managed by the International Exposition Company of New York, N. Y.

K & M exhibits their "Kaytherm," a "diatomic" insulation, normally for pipes but shown here fabricated into a suit for fire fighters

Johns-Manville presents its "metal-on" pipe insulation of high-temperature "Thermobestos" prejacketed at the factory with aluminum, strong and corrosion resistant. It's furnished as an integral package.

Demonstrating the IBM 1620 Data Processing System, which uses decimal notation throughout, eliminating programmed conversion. It prints reports automatically, including alphabetic information.

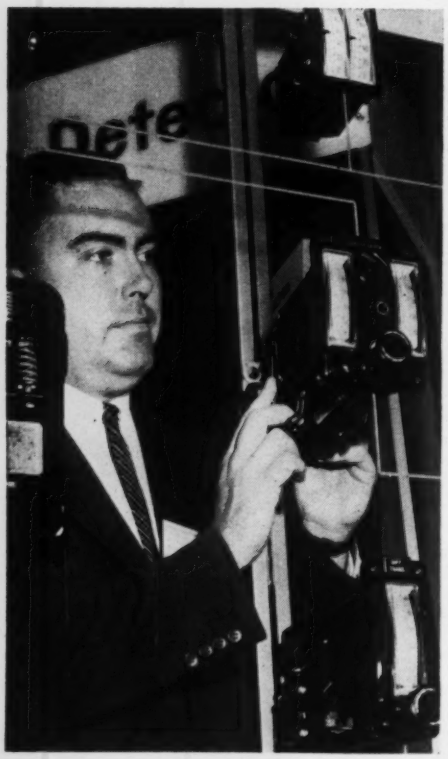
INCO shows nickel-containing alloys for boilers, superheaters, turbines, and valves for nuclear as well as conventional high-pressure power plants

Green Fuel Economizer Company, Inc., presents a new application for its "Aerodyne" dust collector as a precleaner for turbo blowers

ASME presents its wares in the form of publications. On view were many of the more than 350 publications with which the Society carries out its responsibilities to the profession.

"Live" exhibit. Republic Steel operates a small demonstration unit of the "Farrowtest" machine, an electronic device for detecting irregularities in tubing.

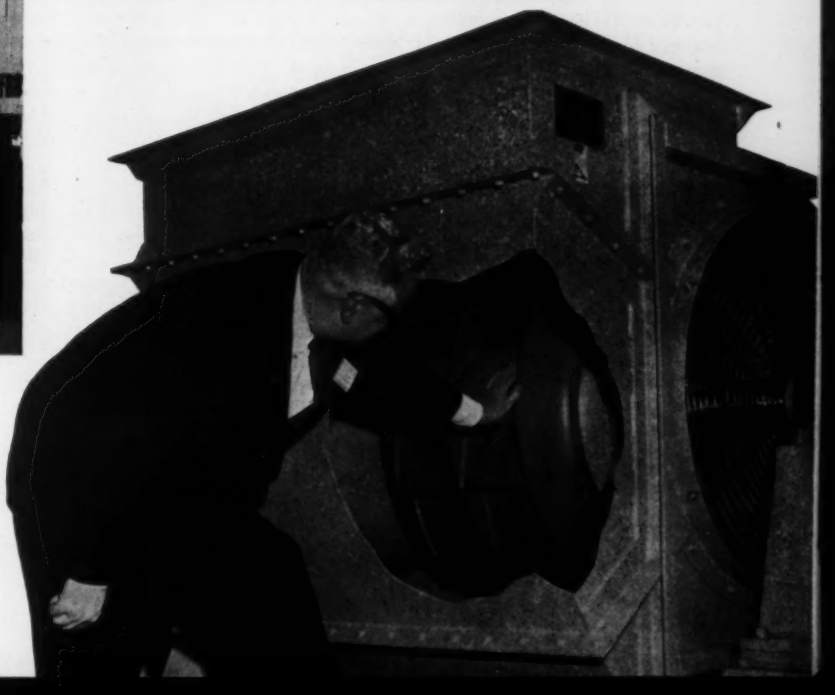
Bailey Meter Company demonstrates automatic control of power installations—control of temperature and pressure by pneumatic, instead of electric, means



The dance of the nuclear forgings. U. S. Steel's exhibit featured the "phonomime" trick—pretty girl does a silent "monologue" with dance steps: To hear her you must pick up the phone. Makes you want a forging.

The Power Piping Division of The W. M. Kellogg Company serves electric utilities all over the world, from its new Williamsport, Pa., plant

Niagara Blower Company lays it on the line. Air conditioners, drying equipment, heat exchangers, condensers, fan heaters, aftercoolers, air liquefaction.



The inside story. The Chicago Blower Corporation exhibited this centrifugal blower, cut away to show the innards.

ASME Honors Engineers

See Machine Design Award, p. 109

Biographies of recipients, and descriptions of ASME Honors and Awards bestowed in 1960

WHAT reward does an engineer receive? There are many, but the greatest reward for his accomplishment is recognition by his fellow engineers. This recognition is one of the major purposes of The American Society of Mechanical Engineers.

The Society's honors were customarily conferred at the Annual Banquet but, with the tremendous growth of the engineering profession and the increase in the numbers of honors, it was decided that decentralization of the presentations of honors would provide oppportunity for more members to witness the presentations. This, at the same time, would do more to honor the recipients.

Accordingly, the presentations this year took place at the President's Luncheon on Monday, others at the Applied Mechanics Dinner, the Machine Design Luncheon, the Members and Students Luncheon, and the Banquet.

Earlier in the year, at the ASME-AIEE National Power Conference the ASME George Westinghouse Gold Medal was presented. At the same joint conference the Prime Movers Committee Award was also conferred.

The Society is proud of the honors it bestows and takes this opportunity to congratulate the recipients and to provide the general membership with some information about the honors and the recipients.

THE Society's first honor is Honorary Membership in ASME. This is conferred for acknowledged distinctive accomplishment in engineering, or science, or industry, or research, or public service, and those allied pursuits beneficial to the engineering profession.

HONORARY MEMBERSHIP

H. T. Heald

HENRY TOWNLEY HEALD, Mem. ASME, president of The Ford Foundation, was honored for his outstanding accomplishments as an educator and public servant.

Mr. Heald, active in civic and industrial affairs in Chicago and in New York, was appointed president of The Ford Foundation on Oct. 1, 1956. Prior to this, 29 years of his career were devoted to American higher education where he held such positions as president of Armour Institute of Technology, Chicago, Ill., president of Illinois Institute of Technology, president of Armour Research Foundation, president of the Institute of Gas Technology, and Chancellor and president of New York University.

He has been president of the American Society for Engineering Education, president of the Western Society of Engineers, president of the Association of Urban Universities, chairman of the American Council on Education, vice-president of the Chicago Association of Commerce and Industry, vice-president of the Greater Chicago Safety Council, vice-chairman of the Mayor's (New York) Committee on Better Housing, vice-president of the National Safety Council, and vice-chairman of the Engineers' Council for Professional Development.

In Chicago, he was chairman of the Mayor's Committee on the Board of Education which investigated and instituted reforms in the city school system. He was chairman of the South Side Planning Board which launched a slum-clearance program on Chicago's South Side. He also was president of the Citizen's Building Code Committee and a commissioner and vice-chairman of the Land Clearance Commission.

In New York, Mr. Heald was chairman in 1956 of the Temporary State Commission on Educational Finances, whose work resulted in new legislation governing state support of public education. In 1959, he served as chairman of a committee appointed by the State Commissioner of Education to investigate charges of waste and extravagance in the New York City public-school system. Currently, he is chairman of a three-man committee appointed by the Government to evaluate the needs of higher education in the State of New York. He was a member of the Board of the National Merit Scholarship Corporation and is a Trustee of Teachers Insurance Annuity Association Stock and a Member of the College Retirement Equities Fund.

Mr. Heald's former business affiliations include directorships in American

Steel Foundries, First Federal Savings and Loan Association, and Peoples Gas Light and Coke Company, all in Chicago. At present, he is a director of Equitable Life Assurance Society of the United States, Stewart-Warner Corporation, Swift and Company, and the American Telephone & Telegraph Company.

Many honorary degrees and awards have been bestowed on Mr. Heald; of these, the most famous awards are as follows: The Navy Award for Distinguished Civilian Service, the Washington Award of the Western Society of Engineers, selection in 1940 as one of the ten outstanding young men of the nation by the National Junior Chamber of Commerce, the Gold Medal of the National Institute of Social Sciences, and the Hoover Medal. Conferred at Winter Annual Banquet, Thursday, Dec. 1, 1960.

HONORS AND AWARDS

ASME MEDAL

THE ASME MEDAL was established by the Society in 1920. It is to be presented annually, together with an engrossed certificate, for distinguished service in science and engineering and it may be awarded also for general service in science having possible application in engineering.

C. Richard Soderberg

CARL RICHARD SODERBERG, Fellow ASME, Institute Professor, The Massachusetts Institute of Technology, was awarded the ASME Medal for his contributions to the development of steam and gas turbines for power generation and for propulsion units in naval vessels and aircraft.

Dr. Soderberg, born in Ulvöhamn, Sweden, is an internationally eminent engineer, who became a naturalized American citizen in 1927. He was graduated from Chalmers Institute of Technology in Gotebörg, Sweden, in 1919, and from M.I.T. in 1920 with a BS degree in Naval Architecture. Dr. Soderberg has been honored for his contributions to the literature of the engineering profession, as well as his effective part in the advancement of this art, not only in the U. S. but abroad as well. He has contributed to the development of the basic elements of steam-turbine equipment by the many recognized patents he holds. These contributions have been major factors in making possible the modern large compact high-speed units with the economies afforded by use of high temperatures and pressures.

During World War II, he was a member of the Special Committee on Jet Propulsion of the National Advisory Committee for Aeronautics (now NASA). He worked with various divisions of the National Defense Research Committee on tank development, evaluation of gas-turbine drives for ships, and numerous other highly "classified" projects. He belongs to many professional and scientific societies such as: The American Academy of Arts and Sciences, the Institute of the Aeronautical Sciences, National Academy of Sciences, The American Association for the Advancement of Science, the American Association of University Professors, the American Society for Engineering Education, the American Society of Naval Architects and Marine Engineers, the American Society of Swedish Engineers, and The Institution of Mechanical Engineers (Great Britain). He is also a member of Ingeniorsvetenskapsakademien and Svenska Teknologforeningen, Tau Beta Pi, Pi Tau Sigma, and Sigma Xi. He has been awarded the Linnard Prize, an Army-Navy Certificate for civilian service during World War II, an honorary degree of Doctor of Technology from Chalmers Institute of Technology, the John Ericsson Gold Medal, the Exceptional Service Award for services to the U. S. Air Forces in connection with jet propulsion, an honorary degree of Doctor of Engineering from Tufts University. And he was made a Knight of the Order of the North Star by the King of Sweden.

Since 1938, he has extended his constructive impact on the engineering profession by devoting his unique talents to the education of young engineers. His life and his work, his particular achievements, his contributions to American and European technical literature, and his dedicated and inspirational work in engineering education are a credit to his profession. Conferred at Winter Annual Banquet, Thursday, Dec. 1, 1960.

ASME GEORGE WESTINGHOUSE GOLD MEDAL

THE ASME GEORGE WESTINGHOUSE GOLD MEDAL was established and endowed in 1953 by the Westinghouse Educational Foundation. It is awarded for eminent achievement or distinguished service in the power field of mechanical engineering. The basis for the award includes contributions of utilization, application, design, development, research, and the organization and administration of such activities in the power field.

Ernest Charles Gaston

ERNEST CHARLES GASTON, Mem. ASME, president and director of Southern Services, Inc., Birmingham, Ala., was awarded the ASME George Westinghouse Gold Medal for distinguished engineering service in guiding the design and expansion of the Southern Company and in maintaining its service reliability and satisfactory earnings during this period. He also actively participated in planning new methods of generation, including nuclear power.

Mr. Gaston was graduated from the University of Alabama in 1923 with a BS degree in Mechanical Engineering. At present, he is affiliated also with the Mississippi Power Company, Southern Electric Generating Company, Atomic Power Development Associates, Inc., as a director; with the Southern Company as adviser to the Executive Committee. He is a member of the Executive Committee and of the Technical and Engineering Committee for the Atomic Development Associates, Inc., and a member of the Executive Committee and a member of Board of Trustees for High-Temperature Reactor Development Associates, Inc.

His other technical and civic club societies are: Engineers Club of Alabama, Optimist Club, Vestavia Country Club, The Club, Inc.; he was a former member of Prime Movers Committee of Edison Electric Institute. Conferral of the award was made at the ASME-AIEE National Power Conference, Thursday, Sept. 22, 1960.

1960 ASME WINTER ANNUAL MEETING

WORCESTER REED WARNER MEDAL

THE WORCESTER REED WARNER MEDAL was established in 1930 by bequest of Worcester Reed Warner, charter member and sixteenth President of the Society. It is awarded for an outstanding contribution to the permanent literature of engineering. In order to qualify for consideration, such literature must be not less than five years old and be recognized as a noteworthy contribution to the profession.

Lloyd H. Donnell

LLOYD HAMILTON DONNELL, Mem. ASME, senior research scientist, Institute of Science and Technology, University of Michigan (1960–1961), was awarded the Worcester Reed Warner Medal "for his outstanding contributions to the permanent engineering literature as exemplified by his many papers in the field of applied mechanics ranging from the theory of buckling of thin shells to the development of new methods for testing aircraft structure, and his role in establishing *Applied Mechanics Reviews*."

He received his BS in Mechanical Engineering in 1915 and his PhD in Mechanics in 1930, both at the University of Michigan. His career started as an engineer with H. H. Franklin Manufacturing Company, in 1915, and since then he has been connected with the following: Quaker Unit of Red Cross in France; Packard Motor Company; Dodge Brothers; operated small manufacturing company; instructor and assistant professor of mechanics at the University of Michigan; research fellow in charge of Aero-Structure Laboratory at California Institute of Technology; in charge of stress analysis and structural research at Goodyear Zeppelin Corporation; associate professor of Mechanical Engineering and research professor of mechanics at Illinois Institute of Technology (1939 to present), acting chairman of Mechanics Department; in charge of structural development at Chance Vought Aircraft.

Dr. Donnell has served as chairman of Applied Mechanics Division, ASME, in 1951; general chairman of the First U. S. National Congress of Applied Mechanics, in 1951; member of the National Council, FAS, 1952–1953. He is Founding Editor of *Applied Mechanics Reviews*, having served as editor from 1948 to 1950. FAS, AAUP, Sigma Xi, and Tau Beta Pi are other organizations with which he is affiliated. Conferred at Applied Mechanics Dinner, Tuesday, Nov. 29, 1960.

TIMOSHENKO MEDAL

THE TIMOSHENKO MEDAL was established in 1957 to be conferred annually in recognition of distinguished contributions to applied mechanics. It was instituted by the Applied Mechanics Division of the Society to honor Stephen P. Timoshenko, Hon. Mem. ASME, world-famed authority in the field, and to commemorate his contributions as author and teacher.

Richard Grammel

PROF. DR. RICHARD GRAMMEL is founder and editor of the journal, *Ingenieur-Archiv*.

Born in Klosterreichenbach, Germany, he received his education as a collegian of mathematics and physics at the Universities of Munich and Tuebingen; as a collegian of mechanical engineering at Stuttgart and Munich Institutes of Technology.

In 1913, he was awarded Dr. scient. nat. at the University of Tuebingen; in 1929, Dr. scient. techn. honoris causa at Zurich Federal Institute of Technology; in 1948, made Ehrenbuerger (honorary freeman) of the Stuttgart Institute of Technology; in 1960, received the Grashof Medal of the Verein Deutscher Ingenieure.

During his career, he has been an assistant professor, full professor, and president of a University, coeditor, coauthor, and author. In the literary field, Dr. Grammel has many achievements to his credit. He has written several books—one being, "Technishe Dynamik" (with Biezeno)—and more than a hundred scientific papers on spinning tops, vibrations, critical speeds of rotation, elastic problems, thermodynamics, and so on.

Dr. Grammel holds a fellowship in the following: Deutsche Akademie der Naturforscher Leopldina; Deutsche Akademie der Luftfahrtforschung; Institute of the Aeronautical Sciences; Mainzer Akademie der Wissendemie der Wissenschaften (Munich); Oesterreichische Akademie der Wissenschaften (Vienna); Heidelberger Akademie der Wissenschaften; Accademia di Bologna.

He has been a member of such committees as the Congress of Applied Mechanics, German Research Council, German Research Community, Bureau of the International Union of Theoretical and Applied Mechanics, the German UNESCO Committee, and was president of the Society of Applied Mathematics and Mechanics.

C. B. Biezeno

CORNELIS BENJAMIN BIEZENO, lecturer and author, also was named recipient of the Timoshenko Medal.

Prof. Dr. Biezeno received his mechanical engineer's degree cum laude from the Technological University at Delft, where he held, at one time, the status of Rector Magnificus of the University. During his career, he has served as professor, lecturer, and also president of the First International Congress for Applied Mechanics (Delft) and of the International Committee of the International Congresses for Applied Mechanics (the tenth, held in 1960).

Dr. Biezeno has received many honors and awards and honorary degrees—one being Knighthood of the Order of the Dutch Lion. In 1932, he was awarded Doctor honoris causa of the Municipal University of Amsterdam; in 1956, Doctor honoris causa of the Faculté de Sciences Appliquées de l'Université de Bruxelles; in 1959, Doctor honoris causa of the Faculteit van Tolgepaste Wetenschappen der Rijksuniversiteit te Gent.

He is coauthor of "Technische Dynamik," which has been translated into English, Russian, and, in part, Spanish. His publications can be found in an "Anniversary Volume," which was presented to him by a number of Dutch and foreign scientists.

Drs. Grammel and Biezeno were chosen to receive the Timoshenko Medal "for invaluable contributions to applied mechanics, numerous individual publications, joint authorship of the widely accepted book, 'Technische Dynamik,' and inspiring leadership in the International Congresses of Applied Mechanics." Conferred at Applied Mechanics Dinner.

MACHINE DESIGN AWARD

THE MACHINE DESIGN AWARD is a new award, established in 1959 by the Machine Design Division to recognize eminent achievement or distinguished service in the field of machine design.

R. E. Peterson

RUDOLPH EARL PETERSON, Fellow ASME, was awarded the Machine Design Award "for eminent achievement and distinguished service in the field of mechanical design, for numerous creative contributions and teaching in research, development, application, and design of machinery to prevent mechanical failure; for outstanding accomplishment in the development of young engineers and scientists both through his industrial and his university associations."

With a BS in Mechanical Engineering and an MS in Theoretical and Applied Mechanics (both at University of Illinois) to his credit, Mr. Peterson started his professional career which, for the most part, has been spent with Westinghouse in the following departments: Railway Engineering, Motor Engineering, and Research Laboratories. At present, he is manager of the Mechanics Department, Research, and is on the Faculty of Pitt-Westinghouse Graduate Program.

His technical affiliations have been as chairman of ASTM Committee E-9 on Fatigue, ASTM Simulated Service Testing Committee, ASA Committee Z10.3 Mechanics Symbols, past-president of SESA, past-chairman ASME Advisory Board—*Applied Mechanics Reviews*—ASME Applied Mechanics Division, and Director of ASTM.

His literary talents plus his engineering abilities have permitted Mr. Peterson, winner of the ASTM Award of Merit, to write a book, "Stress Concentration Design Factors," as well as several chapters in four handbooks and more than 50 technical papers. Conferred at Machine Design Luncheon, Nov. 29, 1960. **(See photo, p. 106. From left: Dean H. A. Bolz, R. E. Peterson, W. L. Cisler.)**

Honorary
HENRY TOWNLEY HEALD

ASME Medal
CARL R. SODERBERG

Timoshsenko Medal
CORNELIS B. BIEZENO

Westinghouse Medal
ERNEST C. GASTON

Timoshenko Medal
RICHARD GRAMMEL

Machine Design
RUDOLPH E. PETERSON

Worcester Reed Warner
LLOYD H. DONNELL

1960 ASME WINTER ANNUAL MEETING

MELVILLE PRIZE MEDAL FOR ORIGINAL WORK

THE MELVILLE PRIZE MEDAL FOR ORIGINAL WORK was established in 1914 in honor of Admiral George Wallace Melville, Honorary Member and eighteenth president of the Society. It is awarded annually "for the best original paper or thesis on a mechanical engineering subject by a member of ASME presented for discussion and publication during the preceding calendar year."

William G. Steltz

WILLIAM GODFREY STELTZ, development engineer, Steam Division, Westinghouse Electric Corporation, has won the Melville Prize for his paper, "The Critical and Two-Phase Flow of Steam," presented at the ASME Annual Meeting in 1959.

Philadelphia-born William Steltz received his BS in Mechanical Engineering at the College of Applied Science, Syracuse University, where he was elected to the honorary engineering societies of Tau Beta Pi and Pi Tau Sigma. His MS in Mechanical Engineering was conferred by Drexel Institute of Technology, after completion of the evening school requirements.

His field of endeavor has been concentrated in the field of thermodynamics as applied to steam-turbine development and digital-computer applications. Conferral was made at the President's Luncheon, Monday, Nov. 28, 1960.

PRIME MOVERS COMMITTEE AWARD

THE PRIME MOVERS COMMITTEE AWARD was established in 1954 from a fund donated by the Prime Movers Committee of the Edison Electric Institute. It is conferred annually in recognition of outstanding contributions to the literature of thermal electric-station practice or equipment.

James H. Harlow

JAMES HAYWARD HARLOW, Fellow ASME, chief mechanical engineer, Philadelphia Electric Company, has been awarded the Prime Movers Committee Award for his paper "Engineering the Eddystone Plant for 5000 Lb-1200 Deg Steam," presented at the ASME Annual Meeting in 1956.

Mr. Harlow has been connected with the Philadelphia Electric Company since 1923. His many responsibilities have entailed such feats as engineering, design, construction, and preliminary operation work on the utility's major stations, most famous being the Eddystone Station which is a supercritical plant incorporating the most advanced steam pressure and temperature conditions yet attempted in a steam plant.

He has been active on many committees, both local and national, many of his articles have appeared in the *Transactions of the ASME* and other technical journals.

Mr. Harlow, a registered professional engineer in Maryland, New Jersey, and Pennsylvania, is also a Fellow AIEE, a member in ASTM, NSPE, Engineers' Club of Philadelphia, The Franklin Institute, and Tau Beta Pi. Conferral of award was made at the ASME-AIEE National Power Conference, Thursday, Sept. 22, 1960.

Sigmund Nicholas Fiala

SIGMUND NICHOLAS FIALA, Mem. ASME, utilities executive engineer, vice-president and chief engineer, American Electric Power Service Corporation, New York, N. Y., has been awarded the Prime Movers Committee Award for his paper, "First Commercial Supercritical Pressure Steam-Electric-Generator Unit for Philo," presented at the ASME Diamond Jubilee Annual Meeting, 1955.

Austrian-born Sigmund Fiala is a graduate of Stevens Institute of Technology and has been a part of American Electric Power Company since 1934. He has seen this company grow and expand so that today it is one of the world's largest private utilities.

He is a member of many industrial committees and at present is chairman of the Power Generation Committee of the Association of Edison Illuminating Companies. He also has been a member of the Nuclear Power Group Operating Committee and has written numerous articles concerning power generation. Conferred at ASME-AIEE National Power Conference, Thursday, Sept. 22, 1960.

BLACKALL MACHINE TOOL AND GAGE AWARD

THE BLACKALL MACHINE TOOL AND GAGE AWARD is named for Frederick S. Blackall, jr., who served as President of ASME in 1953. It is awarded annually for the best paper or papers submitted to the Society for presentation and publication on a subject clearly concerned with or related to the design or application of machine tools, gages, or dimensional measuring instruments.

D. W. Pessen

DAVID WOLFGANG PESSEN is lecturer, Department of Mechanical Engineering of the Technion, Israel Institute of Technology, Haifa, Israel.

Mr. Pessen studied mechanical engineering at the University of Pennsylvania, where he received his BS and MS degrees. His business career started with Brown Instruments Division, Minneapolis-Honeywell Regulator Company, where he did research and development work on pneumatic controllers and process-control systems. At present, he is lecturing on Machine Design and Automatic Control at Israel Institute of Technology. Award conferred at Machine Design Luncheon, Tuesday, Nov. 29, 1960.

Jakhin Boaz Popper

JAKHIN BOAZ POPPER is project engineer, Scientific Department, Israel Ministry of Defense.

Born in Hamburg, Germany, he came to Israel in 1936 and served with the Israel Army during the War of Independence. He was graduated from the Technion, Israel Institute of Technology in 1951 and received his PhD in 1960. He is also a visiting lecturer for advanced dynamics in the Technion. Many of his articles on mechanisms have been published in various technical journals.

Dr. Popper has participated in many

contests for ingenious mechanisms and has won several prizes. He also holds a patent for a twinworm drive which he developed while designing mechanical computers

Mr. Pessen and Dr. Popper were chosen as recipients of the Blackall Award for their paper "The Twinworm Drive—A Self-Locking Worm-Gear Transmission of High Efficiency," presented at the ASME Annual Meeting in 1959.

JUNIOR AWARD

PRESENTED for the best technical paper delivered before the Society by an Associate Member not more than 30 years of age. This award is made from a fund created in 1914 by Henry Hess, past vice-president of the Society.

Duane R. Olberts

DUANE ROBERT OLBERTS, Assoc. Mem. ASME, born in Iowa, received his BS in Mechanical Engineering from the South Dakota School of Mines and his MS in Mechanical Engineering from the University of Wisconsin.

Having started his professional career in 1952 with Allis-Chalmers Manufacturing Company, he is at present a stress analyst in the Materials Engineering Department of Deere & Company. He had been quite active in the Milwaukee Section of the Society and is now the Junior Representative to the Region VI Student Section Committee.

Gunnar Heskestad

GUNNAR HESKESTAD, Assoc Mem. ASME, was born in Haugesund, Norway; educated in Norwegian elementary and secondary schools and was graduated with a BS in Mechanical Engineering from the University of New Hampshire. He received his MS in 1957 from Purdue University.

His professional career began with the Allis-Chalmers Manufacturing Company in the Research Laboratory. He remained there until 1959 when he left to attend The Johns Hopkins University to work toward his PhD.

Mr. Olberts and Mr. Heskestad received the Junior Award at the President's Luncheon, Monday, Nov. 28, 1960, for their paper, "Influence of Trailing-Edge Geometry on Hydraulic-Turbine-Blade Vibration Resulting From Vortex Excitation," presented at the Hydraulic Conference in 1959.

Prime Movers

SIGMUND N. FIALA

Junior

DUANE OLBERTS

JAMES HARLOW

GUNNAR HESKESTAD

Melville

WILLIAM STELTZ

Williston

MARC FISHZOHN

Blackall

JAKHIN BOAZ POPPER

Pi Tau Sigma

GEORGE HATSOPOULOS

DAVID WOLFGANG PESSEN

1960 ASME WINTER ANNUAL MEETING

Richards Memorial

ASCHER H. SHAPIRO

Undergraduate Student

THEODORE C. KUCHLER, JR.

Charles T. Main

JOHN W. McDANIEL

Old Guard

JOSEPH W. LINDSEY

ARTHUR L. WILLISTON MEDAL AND AWARD

THE ARTHUR L. WILLISTON MEDAL AND AWARD, established in 1954 by ASME Member Arthur L. Williston, is given for the best thesis by an undergraduate student or a junior engineer on a prescribed topic of changes in, or additions to, engineering college curriculums designed to encourage civic responsibility and interest in constructive social or public activities.

Marc Fishzohn

THE 1960 recipient of the Arthur L. Williston Medal and Award is MARC FISHZOHN, who was graduated from Cornell University, Ithaca, N. Y., in June, 1960. Mr. Fishzohn was chosen for this award for his paper, "The Difficult Perspective."

He has participated in many extracurricular and community activities and belongs to several honorary and pro fessional societies. Mr. Fishzohn resides in Rye, New York. Award conferred at the Members and Students Luncheon, Thursday, Dec. 1, 1960.

PI TAU SIGMA GOLD MEDAL AWARD

GIVEN annually for outstanding achievement in mechanical engineering within ten years after graduation from college. Achievement may be in any field, including industrial, education, political, research, civic, and artistic.

George N. Hatsopoulos

THE 1960 Pi Tau Sigma Gold Medal Award for outstanding achievement by a young mechanical engineer within ten years after graduation has been conferred on GEORGE N. HATSOPOULOS. Born in Athens, Greece, he received his BS and MS in Mechanical Engineering, his Professional Mechanical Engineering degree, and his SD degree in Mechanical Engineering at Massachusetts Institute of Technology.

At present, he is associate professor in Mechanical Engineering at M.I.T. and president of the Thermo Electron Engineering Corporation, Cambridge. Mr. Hatsopoulos is also responsible for several research projects now being conducted by M.I.T. In the literary field he has written several technical papers as well as scientific reports on stress analysis, thermodynamics, heat transfer, thermo electron engine, and so on. Award conferred at Members and Students Luncheon, Thursday, Dec. 1, 1960.

PI TAU SIGMA RICHARDS MEMORIAL AWARD

THE RICHARDS MEMORIAL AWARD is given annually for outstanding achievement in mechanical engineering within 20 to 25 years after graduation from college. The award, first presented in 1944, was named in honor of Charles Russ Richards, founder of Pi Tau Sigma.

Ascher H. Shapiro

THE 1960 Pi Tau Sigma Richards Memorial Award was won by DR. ASCHER H. SHAPIRO. New York-born, he did his undergraduate work at CCNY where he received his bachelor degree, in 1938, and at M.I.T., his PhD in 1946.

Most of his professional career has been spent in the Mechanical Engineering Department of M.I.T., starting as a teaching assistant in 1938 and rising to professor in 1952. During the years 1943–1946, he worked in a laboratory doing development work on torpedo engines under the sponsorship of OSRD. He was a visiting professor in the Engineering Department at Cambridge University during 1955–1956. Dr. Shapiro has acted as consultant to many industrial corporations in the field of turbomachinery, power, and propulsion engines.

His literary endeavors consist of a two-volume book on the motion of compressible fluids, several sections in other books, and more than 50 papers published in technical journals. He has served on many committees—one being Project Dynamo, which evaluated for the AEC certain economic and technological aspects of nuclear-power production for civilian use.

A member of ASME and many other professional societies and organizations, Dr. Shapiro is working at present at the Massachusetts Institute of Technology striving to improve the quality of education in the engineering sciences in an era of rapidly changing technology. Conferred at Members and Students Luncheon, Thursday, Dec. 1, 1960.

CHARLES T. MAIN AWARD

THIS award was estiblished in 1919 from a fund created by Charles T. Main, past-president of the Society; to be awarded for the best paper within the general subject of the influence of the profession upon public life. The exact subject is assigned annually.

John W. McDaniel

THE recipient of the 1960 Charles T. Main Award is JOHN W. MCDANIEL, a sales-engineering student in the Graduate Training Program of The Trane Company, La Crosse, Wis. He received a Bachelor of Arts degree in 1959, and a BS in Mechanical Engineering in 1960, both from William Marsh Rice University.

Mr. McDaniel, a 2nd Lieutenant, will go on active duty with the Ordnance Corps, at Aberdeen Proving Grounds, Md., in January, 1961. Conferred at Members and Students Luncheon, Thursday, Dec. 1, 1960.

UNDERGRADUATE STUDENT AWARD

THE UNDERGRADUATE STUDENT AWARD, established in 1914 from a fund created by Henry Hess, past vice-president of the Society, is presented for the best paper or thesis submitted by a Student Member.

Theodore C. Kuchler, Jr.

THEODORE C. KUCHLER, JR., was the recipient of the 1960 Undergraduate Student Award for his paper, "Reliability, A New Tool for Design," written while attending Lehigh University.

Pennsylvania-born Mr. Kuchler received his BA in 1959 and his BS in Mechanical Engineering in 1960, both from Lehigh University. He is now doing graduate work at the University of Pennsylvania evening school, and is employed in the Maintenance and Construction Department, E. I. du Pont de Nemours, Gibbstown, N. J. Award conferred at Members and Students Luncheon.

OLD GUARD PRIZE

THE OLD GUARD PRIZE was established in 1956 and is awarded annually for the best presentation by a Student Member. Winners are selected through a series of Regional competitions with a final decision rendered by a panel of judges at the ASME Summer Annual Meeting. The award is made possible by members of the Society who, through long membership or age, have reached dues-exempt status, but who contribute funds for worth-while purposes such as this prize.

Joseph W. Lindsey

JOSEPH W. LINDSEY received his BS degree in Mechanical Engineering from the University of Utah in 1960. Immediately upon graduation, he joined the Advanced Development Section of Hercules Powder Company, Bacchus, Utah. His experience includes summer employment with Thiokol Chemical Corporation as an engineer's aide on the First Stage Minuteman design staff, a tour of duty with the U. S. Army as a refrigeration mechanic, and he is a graduate of the Automotive Mechanics Trade School at Idaho State College. Present duties include advanced work on projects similar to the one presented here. He is a member of ASME, IAS, Tau Beta Pi, Pi Tau Sigma; and is currently doing graduate study at the University of Utah on a part-time basis.

Mr. Lindsey received the Old Guard Prize at the Members and Students Luncheon, Thursday, Dec. 1, 1960, for his paper, "A Cold Flow Study of Nozzle Feeding in a Four-Nozzle Rocket Case."

ASME LECTURERS, 1959-1960

ASME Lecturers, 1959–1960

THE ASME Lectures were instituted to bring to Sections of the Society, on a biennial basis, outstanding speakers on subjects of broad general interest and value to members of the mechanical-engineering profession. During the several years that the Lectures have been established, leading scientists and engineers have been selected for this service. The selection is, in itself, an honor. The Lecturer donates his time and receives no honorarium.

The following is a list of the 1959–1960 ASME Lecturers and their topics.

Samuel B. Batdorf, Electronics and Avionics Division, Lockheed Aircraft Corporation, Los Angeles 22, Calif.
Topic: Problems of Space Navigation.

Kenneth E. Bisshopp, professor of mechanical engineering and Head of Department, Rensselaer Polytechnic Institute, Troy, N. Y.
Topic: Vibration Theory. Some Applications to Mechanical Engineering.

Renato Contini, Senior Research Scientist, New York University College of Engineering, University Heights, N. Y.
Topic: Human Survival in Space.

Robert C. Dean, Jr., Head of Advanced Engineering Department, Ingersoll-Rand Company, Phillipsburg, N. J.
Topic: More Than an Art. More Than a Science.

Harold M. Faigenbaum, Associate Head, Department of Chemistry; and professor of inorganic chemistry, Walker Laboratory, Rensselaer Polytechnic Institute, Troy, N. Y.
Topic: Chemistry in Mechanical Engineering.

Nicholas J. Hoff, Head, Division of Aeronautical Engineering, Stanford University, Stanford, Calif.
Topic: Temperature and Time—Two Parameters of Increasing Importance in the Design of Structures and Machinery.

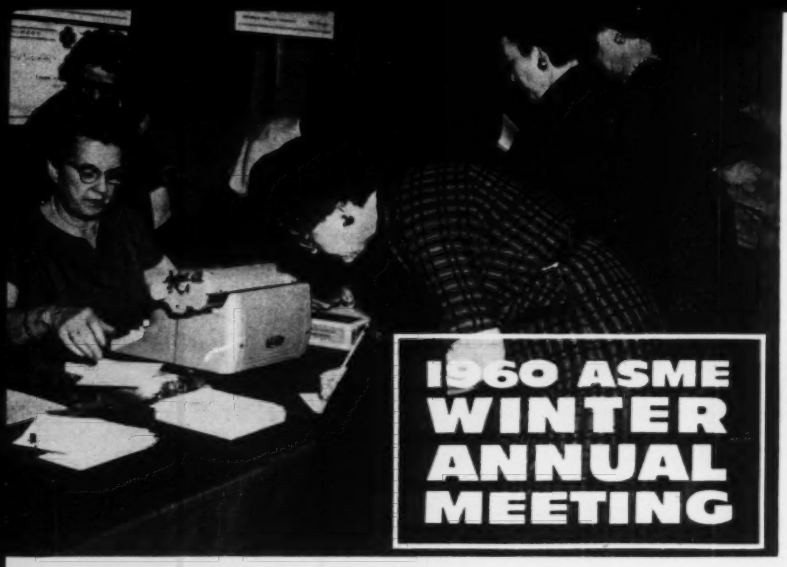
William Littlewood, Vice-President, Equipment Research, American Airlines, Washington, D. C.
Topic: Programs and Progress in Air Transport Development.

Andrew I. McKee, Rear Admiral, USN (Ret.), Vice-President and Director of Research and Design, General Dynamics Corporation—Electric Boat Division, Groton, Conn.
Topic: *USS Squalus*—Rescue and Salvage Operations.

Maynard M. Miller, Geology Department, Michigan State University.
Topic: Man, Glaciers, and Climate.

Dwayne Orton, Editor, *Think*, and educational consultant, International Business Machines Corporation, N. Y. C.
Topic: Tomorrow's Managers.

Allison K. Simons, Director of Research and Engineering, Bostrom Corporation, Milwaukee, Wis.
Topic: Human Factors in Engineering Design.



ASME Woman's Auxiliary

THE Woman's Auxiliary to The American Society of Mechanical Engineers held its Annual Meeting in New York, November 27 through December 2. Mrs. Theodore N. Graser of Boston, re-elected National President of the Auxiliary, was Honorary Chairman of the Meeting.

The Metropolitan Section was hostess for the Meeting. Officers of the Meeting program were: Mrs. Erik Oberg, General Chairman; Mrs. William Byrne and Mrs. John C. Gibb, Vice-Chairmen; Mrs. William Hausmann, Chairman of Metropolitan Section.

Registration. Registration was held on Sunday, November 27, from 2:00 p.m. to 5:00 p.m. and daily throughout the week from 8:00 a.m. to 6:00 p.m. in the Southwest Mezzanine of the Hotel Statler Hilton. A total of 335 women from all parts of the country registered and were warmly greeted as they did so by members of the Sunshine Committee. Many enjoyed the daily coffee hour (8:30-9:30 a.m.) in the Ladies' Headquarters for the opportunity it gave to meet members from other Sections and to exchange ideas.

Early Bird Party. The Sunday get-together, from 4:00 to 7:00 p.m. at the Carnegie Endowment Building, 345 East 46th Street (across the street from the new United Engineering Center), as usual, attracted a capacity crowd. The attractive rooms were further enhanced by the Decorations' Committee displays of handsome greens and heather sparked with Christmas ornaments. The visitors were entertained by Miss Mickie Rogers, accordionist, who played request numbers as she strolled from room to room singing popular numbers.

President's Luncheon. Mrs. Theodore N. Graser spoke at the President's Luncheon which was well attended by the ladies as well as the men. Mrs. Graser reported a 400 per cent increase in Auxiliary membership since 1949 and full use of the Auxiliary's Scholarship and Loan Funds, the latter inactive in 1949, whereas today 55 loans are outstanding. Mr. Grobman of Peru is studying at the University of Illinois with a Calvin W. Rice Memorial Scholarship of $1500. Mr. Walkup at the University of South Carolina and Mr. Harstad at the University of North Dakota are recipients of $500 each from the Sylvia W. Farny Scholarship Fund. Mr. Jackson has been awarded $750 from the Marjorie Roy Rothermel Memorial Fund to do graduate work at V.P.I. Mrs. Graser ended her report with the assurance that the Auxiliary was vitally interested in advancing the cause of engineering in our country.

Auxiliary Workshop. The Workshop, which enables Chairmen and delegates from all Sections to consult with National officers on problems pertaining to the Auxiliary, was held from 2:00 to 3:00 p.m. in the Town Room. One of the main problems discussed and clarified by the excellent and alert attendance was that of eligibility and qualifications for Auxiliary membership.

Monday Evening Social Hour. An informal complimentary program for members of the Auxiliary and ASME who crowded into the Georgian Room expectantly at 8:00 p.m. was received with much pleasure. Delightful and talented Japanese artists in native dress provided dances and demonstrations of calligraphy, exhibitions of paper folding, songs with and without piano accompaniment, and a Koto concert. The final number was Auld Lang Syne in Japanese. Refreshments followed.

Annual Business Meeting. The Annual Business Meeting, held on Tuesday at 10:00 a.m. in the Georgian Room foyer, with Mrs. Graser presiding, was opened with a silent invocation. Presented to the members attending were outgoing ASME President Walker Cisler, incoming President William Byrne, Past-President, Glenn B. Warren, and ASME Secretary, O. B. Schier, II. Officers and chairmen of Committees then gave their reports. The newly elected officers, announced by Mrs. Adrain H. Westbrock of Buffalo, include:

President, Mrs. Theodore N. Graser—Boston
First Vice-President, Mrs. William H. Larkin—Metropolitan
Second Vice-President, Mrs. C. H. Kent—Metropolitan
Third Vice-President, Mrs. R. A. Russell—Kansas
Fourth Vice-President, Mrs. E. W. Allardt—CAM
Fifth Vice-President, Mrs. C. W. Hathaway—West Virginia
Corresponding Secretary, Mrs. F. H. Fowler, Jr.—Philadelphia
Recording Secretary, Mrs. Otto S. Pike—Boston
Treasurer, Mrs. John Wilkenfeldt—Metropolitan
Mrs. D. J. MacDonald—Philadelphia

The meeting adjourned with the appointment of the Nominating Committee for next year:

Mrs. Samuel S. Board, Jr.—Metropolitan
Mrs. Charles E. Crede—Southern California
Mrs. Clarence C. Franck—Philadelphia
Mrs. G. E. Nevill—South Texas
Mrs. Warren Scoville—Boston

A Sandwich Luncheon was then served in the Cornell Room to all attending the meeting.

Singer Virginia Marsh Gerleman, featured at Annual Luncheon and Fashion Show, awaits cue

Getting together at Annual Luncheon are from **left:** Mrs. F. D. Vermilya, John Burt, Mrs. Erik Oberg, and Mrs. John C. Gibb. Mr. Burt, the speaker, is a member of the American Technical Delegation to the United Nations.

Mrs. Theodore N. Graser, National President of the Woman's Auxiliary

Enjoying a chat are **left to right:** Mrs. W. H. Byrne, Mrs. O. B. Schier, II, and Mrs. W. L. Cisler

At Tea Dance waiting to be served are from **left:** Mrs. Byrne and Mr. and Mrs. R. W. Worley

Mrs. William Hausmann, Metropolitan Section Chairman

ASME Director Arthur M. Perrin, **center,** stops for refreshments after Japanese Variety program Mrs. Verne Whitacre **is at right.**

Tea Dance. This delightful annual affair in the Georgian Room from 4:00 to 7:00 p.m. on Tuesday again drew a capacity crowd that thoroughly enjoyed dancing to the infectious music of Kayne-Miller's orchestra. The tea table was stunningly effective with a centerpiece of many flowers in a close color harmony in pink and mauve, and candelabra at both ends cast a soft glow of candlelight over the lace cloth and the dainty pink ruffled skirt.

Dinner and Night Club Tour. A capacity bus load took off at 6:30 p.m. Tuesday evening for dinner and the floor show at the Copacabana, then on to hear the "hot" jazz at Sammy's on the Bowery, then on to the Hawaiian Room at the Lexington Hotel, returning late but happy to the Statler Hilton.

National Board Breakfast and National Board Meeting. Wednesday morning at 8:30 the National Board convened in the Terrace Lounge for breakfast and a meeting, with Mrs. Graser presiding. The question of organizing the wives of student ASME members came up for discussion and Mrs. Graser appointed a committee to consider this further. Mrs. W. F. Friend, Chairman of the Student Loan Fund, requested Board authorization for nine loans, two to be granted at once, seven in the immediate future. The Chairman of the Scholarhip Funds reported their committees were at work on applications coming in from many sources.

Exhibition of Handmade Silver Jewelry and Handcrafts. Mrs. Christian Bertelsen, a silversmith and talented craftsman, displayed her beautiful jewelry and handcrafts at 9:30 a.m. in the Southwest Mezzanine. Mrs. Bertelsen, an active member of the Metropolitan Section, also showed attractive Christmas ornaments and told how she makes them. The program was most popular.

Annual Luncheon and Fashion Show. At 12:30 p.m. Wednesday, guests entered the Terrace Ballroom for the Annual Luncheon. The room was decorated beautifully with sparkling gold metal trees on the head table and smaller trees of pastel green nylon on the individual tables—all the trees handmade by the committee. All remained standing by their seats after entering the room while "The Lord's Prayer" (Malotte) was sung by Virginia Marsh Gerleman, accompanied at the piano by Loretta Novotna. Following the Luncheon, and the welcome and introduction of the Head Table by the General Chairman, John Burt spoke; his subject: "Peaceful Uses of Atomic Energy." Mr. Burt is a member of the American Technical Delegation to the United Nations. Jantzen, Inc. then put on a sprightly fashion show entitled "Jantzen Fashions —Smiles of 1961." Door and table prizes were then distributed.

Dinner at Leone's Restaurant and Theatre Party. A large proportion of the many who had purchased tickets to the Mary Martin hit musical, "The Sound of Music," went to Leone's famous restaurant at 6:30 p.m. Wednesday evening to enjoy the full-course dinner served in time, by special arrangement, so that all ticketholders could reach the Lunt-Fontanne Theatre before the curtain went up.

Tour of Steuben Glass and Tour of Union Carbide Building. A great interest prevails in crystal design as was shown by the number who went to 715 Fifth Avenue, 9:00 a.m. Thursday morning, to see the fabled collection of crystal at Steuben Glass. Those taking the concurrent tour of the Union Carbide Building on Park Avenue saw one of New York's newest glass skyscrapers, a breathtaking exhibit—"Atomic Energy in Action" (see MECHANICAL ENGINEERING, December, 1960, p. 109) and a remarkable movie—"The Petrified River."

Luncheon at Luau 400 Restaurant. A Polynesian menu in an exotic South Sea Island setting made the Luau Luncheon at noon, Thursday, a special event. Cakes especially decorated with the ASME insignia were much admired. Movies, singing, dancing, and guitar playing—island style—provided a full program of entertainment. The affair closed with "Aloha" from the General Chairman who wished all Godspeed, a safe journey home, and to give her the pleasure of greeting them all again next year.

Tour of Guggenheim Museum. At 9:30 a.m. Friday, those who wanted to see New York's number-one tourist attraction and Frank Lloyd Wright's most controversial architectural design departed for the Guggenheim Museum at 1071 Fifth Avenue.

Mrs. Erik Oberg, the General Chairman, deeply appreciates and thanks all the donors who contributed so generously toward the support of the program, and all the committee members whose deep interest, co-operation, and teamwork have made it possible to once again bring the Annual Meeting to a successful conclusion. A special "thank you" to all Chairmen who include the following Members:

Chairmen	Vice Chairmen
Mrs. R. W. Oakley, Registration	Mrs. T. A. Burdick, Mrs. J. W. Earl, Mrs. W. A. Pool
Mrs. Verne Whitacre, Sunshine Committee	Mrs. Crosby Field, Mrs. A. M. Perrin
Mrs. Rudolph F. Gagg, Floral Decorations	Mrs. R. S. Copper, Mrs. V. Whitacre
Mrs. Roland S. Cooper, Early Bird Party	Mrs. A. H. Beaufrere, Mrs. R. F. Gagg, Mrs. J. Teufel
Mrs. C. H. Kent, Auxiliary Workshop	Mrs. A. R. Cullimore, Mrs. W. F. Friend
Mrs. N. G. Willen, Monday Social Hour	Mrs. C. Bertelsen, Mrs. W. D. Temple
Mrs. Christian Bertelsen, Sandwich Luncheon	Mrs. W. Becker, Mrs. J. W. Wilkenfeldt
Mrs. Harry R. Kessler, Tea Dance	Mrs. A. B. Curtis, Mrs. J. W. Wilkenfeldt
Mrs. J. T. Vollbrecht, Night Club Tour	Mrs. H. A. Johnson, Mrs. W. D. Temple
Mrs. Harry R. Kessler, Jewelry Program	Mrs. K. J. Ray, Mrs. E. J. Sharkey, Jr.
Mrs. Floyd D. Vermilya, Annual Luncheon and Fashion Show	Mrs. A. B. Curtis, Mrs. C. J. Ruzicka, Mrs. A. M. Perrin
Mrs. J. W. Wilkenfeldt, Models for Fashion Show	
Mrs. G. T. Felbeck, Pre-Theatre Dinner at Leone's	Mrs. G. R. Hahn, Mrs. D. H. Riley
Mrs. Joseph J. Moro-Lin, Theatre Party	Mrs. D. Scolaro, Mrs. J. W. Wilkenfeldt
Mrs. John E. Stevens, Tour of Steuben Glass	Mrs. J. L. Mazaika, Mrs. C. J. Ruzicka
Mrs. W. Wockenfuss, Tour of Union Carbide	Mrs. W. Becker, Mrs. C. R. Mockridge
Mrs. Frederick A. Thoene, Luncheon at Luau 400	Mrs. C. H. Kent, Mrs. R. B. Skinner
Mrs. A. M. Feldman, Guggenheim Museum Tour	Mrs. M. A. Michal, Mrs. B. Skolnikoff

And special thanks to two Fashion Show models secured too late to appear in the printed program: Mrs. Eugene M. Hunter, Metropolitan Section; and Mrs. John F Vogt, Jr., New Orleans.

1960 Availability List

The papers in this list are available in separate copy form until **Oct. 1, 1961.** Please order only by paper number; otherwise the order will be returned. You can save the postage and handling charges by including your check or money order made payable to ASME with your order and sending both to the ASME Order Department, 29 West 39th Street, New York 18, N. Y. Papers are priced at **50 cents** each to members; **$1** to nonmembers. Payment also may be made by free coupons distributed annually to members, or coupons which may be purchased from the Society. Coupons, in lots of ten, are $4 to members; $8 to nonmembers.

Applied Mechanics

60—WA-14 Steady State Behavior of Nonlinear Dynamic Vibration Absorber, by W. J. Carter and F. C. Liu

60—WA-15 The Penetration of Hard-Steel Spheres Into Plane Metal Surfaces, by Werner Goldsmith and P. T. Lyman

60—WA-16 A Nondestructive Three-Dimensional Strain-Analysis Method, by A. J. Durelli and I. M. Daniel

60—WA-17 A New Approach to the Analysis of the Deflection of Thin Cantilevers, by R. Frisch-Fay

60—WA-18 On the Probability Densities of the Output of Some Random Systems, by Frank Kozin

60—WA-19 Stress Distribution in a Rotating Spherical Shell of Arbitrary Thickness, by M. A. Goldberg, V. L. Salerno, and M. A. Sadowsky

60—WA-20 Heat Transfer and Sublimation at a Stagnation Point in Potential Flow, by W. W. Short

60—WA-21 Vibrations of Elastic Sandwich Cylindrical Shells, by Yi-Yuan Yu

60—WA-22 Propagation of Axisymmetric Waves in an Unlimited Elastic Shell, by A. Kalnins and P. M. Naghdi

60—WA-23 Information Theory as the Basis for Thermostatics and Thermodynamics, by Myron Tribus

60—WA-24 An Improved Integral Procedure for Compressible Laminar Boundary-Layer Analysis, by Kwang-Tzu Yang

60—WA-25 Transient Heat Conduction in a Rod of Finite Length With Variable Thermal Properties, by W. H. Chu and H. N. Abramson

60—WA-26 On the Stability of the Linearly Related Modes of Certain Nonlinear Two-Degree-of-Freedom Systems, by C. P. Atkinson

60—WA-27 Random Excitation of a System With Bilinear Hysteresis, by T. K. Caughey

60—WA-28 Forced Oscillations of a Semi-Infinite Rod Exhibiting Weak Bilinear Hysteresis, by T. K. Caughey

60—WA-29 On the Compressibility Effects of the Lubricant for Two-Dimensional Slider Bearings, by K. T. Yen

60—WA-30 Stresses and Deflections in an Elastically Restrained Circular Plate Under Hydrostatic Normal Pressure Over a Segment, by W. A. Bassali and N. O. M. Hanna

60—WA-31 A Modification of the Coulomb-Mohr Theory of Fracture, by Burton Paul

60—WA-32 On the Bending of Circular Cylindrical Shells by Equal and Equally Spaced End Radial Shear Forces and Moments, by Paul Seide

60—WA-33 On the Buckling of Circular Cylindrical Shells Under Pure Bending, by Paul Seide and V. I. Weingarten

60—WA-38 The Bending, Buckling, and Flexural Vibration of Simply Supported Polygonal Plates by Point-Matching, by H. D. Conway

60—WA-49 An Exploratory Study of Three-Dimensional Photothermoelasticity, by H. Tramposch and G. Gerard

60—WA-102 The Effect of Shear and Normal Forces on the Fully Plastic Moment of a Beam of Rectangular Cross Section, by B. G. Neal

60—WA-103 Experiments on the Postbuckling Behavior of Square Plates Loaded in Edge Compression, by Noboru Yamaki

60—WA-104 Adiabatic Analysis of Elastic, Centrally Pivoted, Sector, Thrust-Bearing Pads, by B. Sternlicht, G. K. Carter, and E. B. Arwas

60—WA-105 Torque and Cavitation Characteristics of Butterfly Valves, by Turgut Sarpkaya

60—WA-106 On the Response of Linear Systems to Time-Dependent, Multidimensional Loadings, by F. P. Beer

60—WA-123 Transient Thermal Stresses in a Circular Cylinder, by C. K. Youngdahl and Eli Sternberg

60—WA-124 On Transient Thermal Stresses in Viscoelastic Materials With Temperature-Dependent Properties, by Rokuro Muki and Eli Sternberg

60—WA-125 On the Burmester Points of a Plane, by F. Freudenstein and G. N. Sandor

60—WA-201 Transient Capillary Rise in Reduced and Zero-Gravity Fields, by Robert Siegel

60—WA-202 The Elastic Plane With a Circular Insert, Loaded by a Radial Force, by J. Dundurs and M. Hetényi

60—WA-203 The Laminar Boundary Layer on a Hot Cylinder Fixed in a Fluctuating Stream, by R. J. Gribben

60—WA-204 On the Dynamic Behavior of a Frank-Read Source, by J. D. Campbell, J. A. Simmons, and J. E. Dorn

60—WA-205 Investigation of Flat-Plate Hypersonic, Turbulent Boundary Layers With Heat Transfer, by Eva M. Winkler

The following papers comprise the book entitled, "Shock and Structural Response." Price $4.50 a copy ($3.60 to ASME members). Papers are not available separately.

Shock Loading and Response Spectra, by Y. C. Fung

Measurement of Shocks, by Irwin Vigness Concepts in Shock Testing Equipment, by Charles E. Crede

Response of Structural Systems to Ground Shock, by Dana Young

Ground Shock and Missile Response, by Millard V. Barton

Aviation

60—WA-178 Calibration Techniques in Ultra-High-Pressure Apparatus, by F. P. Bundy

60—WA-195 Use of a Centrifuge for the Precision Measurement of Accelerometer Characteristics, by S. R. Sporn

60—WA-224 A Tip-Turbine Driven Lift Fan for VTOL Aircraft, by A. P. Adamson and B. H. Rowe

60—WA-246 The Performance of Gyroscopes in a Vibration Environment, by W. E. Fellows

60—WA-247 Gyro Micro-Yield Measurements on a Precision Linear Vibrator, by P. J. Palmer

60—WA-254 The Application of the Pinch Process for Space Propulsion, by I. Granet and W. J. Guman

60—WA-268 Special Pilot Considerations for Sweptwing Jet Transports, by W. Haldeman

60—WA-271 High - Pressure Research in Metallurgy, by J. E. Hilliard

60—WA-274 Automated Maintenance and Airline Economy for Supersonic Aircraft, by E. R. Woods and C. L. Blake

60—WA-275 Tactical and Operational Advantages Attainable by Superperformance Aircraft Rocket Engines, by C. R. Bell

60—WA-280 System Test Techniques for Mach 3 Aircraft, by A. C. Fulkerson and M. Pollack

60—WA-288 Heavy Presses in the Space Age, by L. W. Mayer

60—WA-291 Electrical Propulsion Applications and System Requirements, by C. J. McDole

60—WA-292 Investigation of Gas Turbine as a Prime Mover in Petroleum Servicing Industry, by D. H. Hathorn and J. K. Arnold

60—WA-295 Low-Thrust Propulsion for Mars Transfer Missions, by H. Brown

60—WA-302 Large Radar-Antenna Servodrive Employing High-Horsepower, Eddy-Current Clutches, by W. L. Hinks and D. L. Brown

60—WA-316 Forgings for Missiles and Space Vehicles, by J. R. Canal and W. C. Kunkler, Jr.

60—WA-317 Aspects of Heavy Press Utilization, by J. Brayman

60—WA-319 Lateral Frequencies of Vibration of Helical Extension Springs, by Joseph C. Dunn

60—WA-320 The Filament-Wound Pressure Cylinder. . .A State of the Art Report, by R. E. Young

60—WA-323 Determination of the Modes of Vibration of a Single-Barrel Rocket-Engine System When Vertically Mounted on a Test Stand. by W. B. Small and R. A. Hinker

60—WA-326 Hydrofoil Boat Hull-Wave Impact Loads, by W. R. Jensen

60—WA-330 Automatic Checkout Equipment on Military Aircraft, by R. G. Lohmann

60—WA-331 Ultra-High Pressure Physics, by W. G. Field

60—WA-332 Turboshaft Power for Marine Propulsion, by G. A. Hardgrove

60—WA-333 Equipment for Ultra-High Pressure Work, by A. Zeitlin

Boiler Feedwater Studies

60—WA-213 Evaluation of Steam Washers in Power-Plant Boilers, by H. A. Klein

60—WA-214 Vacuum Deaerator Design, by A. W. Kingsbury and E. L. Phillips

60—WA-216 The Relation Between Boiler Cleanliness and Feedwater, by F. U. Neat

60—WA-217 Performance of Stainless-Steel Condenser Tubes, by R. H. Pell

60—WA-219 Acid Cleaning of Superheaters and Reheaters, by W. F. Ashton and S. M. Rose

60—WA-221 Precautions in the Use of Citric Acid for Chemical Cleaning, by E. B. Morris

60—WA-257 Chemical Cleaning With Citric-Acid Solutions, by W. E. Bell

60—WA-258 Chemical Cleaning of Controlled-Circulation Boilers, by H. J. Vyhnalek

60—WA-259 New Chemical Cleaning Concepts and Possible Applications for the Future, by C. M. Loucks

60—WA-262 Chemical Cleaning of Preboiler Equipment, by W. B. Willsey

Corrosion and Deposits

60—WA-180 Corrosion of Superheaters and Reheaters of Pulverized-Coal-Fired Boilers, II, by C. Cain, Jr., and W. Nelson

60—WA-182 The Role of Chemical Thermodynamics in Analyzing Gas-Side Problems in Boilers, by R. H. Boll and H. C. Patel

60—WA-183 A Study of Sulfur Reactions in Furnace Deposits, by M. Weintraub, S. Goldberg, and A. A. Orning

60—WA-255 Effect of Ammonia Injection on Corrosion in Air Preheaters, by R. Kato and B. E. Paris

60—WA-260 New Developments for Handling the Fuel-Oil-Ash Corrosion Problem, by D. W. McDowell, Jr., and J. R. Mihalisin

60—WA-278 Reactions of Magnesium With Inorganic Constituents of Heavy Fuel Oil and Characteristics of Compounds Formed, by W. D. Niles and H. R. Sanders

60—WA-284 Slurry Spraying for the Control of Corrosion and Deposits in Oil-Fired Boilers, by W. F. Cantieri and R. E. Chappell

Fluid Meters

60—WA-137 Expansion Coefficients for Orifice Meters in Pipes Less Than One Inch in Diameter, by G. A. Marxman and H. Burlage, Jr.

60—WA-141 Flow Measurement for Accounting Purposes, by D. D. Livingstone

60—WA-142 Gas-Tracer Method of Steady and Pulsating-Flow Measurement, by J. F. Kemp

Fuels

60—WA-285 Dewpoint Meter Measurements in Boiler Flue Gases, by A. W. Black, C. F. Stark, and W. H. Underwood

60—WA-318 The Use of Fuels in the Cement Industry, by F. B. Tripp

60—WA-327 Tangential Firing of Regenerator Waste Gas in CO Boilers, by J. G. Singer and S. S. Blackburn, Jr.

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60—WA-329 The Significance of the Hall Effect for Three MHD Generator Configurations, by L. P. Harris and J. D. Cobine

60—WA-334 Effect of Combustion Conditions on Nitrogen Oxide Formation in Boiler Furnaces, by J. D. Sensenbaugh and J. Jonakin

Gas Turbine Power

60—WA-77 Shock Losses in Transonic Compressor Blade Rows, by G. R. Miller, G. W. Lewis, Jr., and M. J. Hartmann

60—WA-84 The MU-CYL-JET—The Multicylinder Turbojet Engine, by R. W. Pinnes

60—WA-93 The J83 Seven-Stage Transonic Compressor, by J. A. King

60—WA-97 Résumé of Transonic-Compressor Research at NACA Lewis Laboratory, by S. Lieblein and I. A. Johnsen

60—WA-171 Design and Development of a Transonic Compressor for General Electric's T58 Turboshaft Engine, by M. H. Thorson

60—WA-191 A Practical Method of Predicting Transonic-Compressor Performance, by W. C. Swan

60—WA-200 Stress Analysis of a Radial-Flow Rotor, by M. J. Schilhansl

60—WA-212 Turbocompressor Drive Couplings, by J. H. Anderson

60—WA-229 Aerodynamic Design and Performance of Five-Stage Transonic Axial-Flow Compressor, by K. Kovach and D. M. Sandercock

60—WA-230 A Study of Design Criteria and Matching of Turbomachines: Part A—Similarity Relations and Design Criteria of Turbines, by O. E. Balje

60—WA-231 A Study on Design Criteria and Matching of Turbomachines: Part B—Compressor and Pump Performance and Matching of Turbocomponents, by O. E. Balje

60—WA-270 Aerodynamic Design and Development of the General Electric CJ805-23 Aft Fan Component, by R. A. Novak and L. C. Wright

60—WA-290 Critical Highlights in the Development of the Transonic Compressor, by R. O. Bullock

60—WA-293 The Rotating Nozzle (Hero's) Turbine, by J. F. Brady

60—WA-294 A Review of Supersonic Compressor Development, by J. F. Klapproth

60—WA-297 Description of a Marine-Auxiliary 250-KW Variable-Frequency Gas-Turbine-Driven Generator Set, by G. R. Wagner, L. Cohen, and D. J. Todd

60—WA-310 Some Investigations Into Transonic Axial-Flow Compressors With High Stage-Load and Low Degrees of Reaction, by K. E. Wichert

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Heat Transfer

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60—WA-98 A Variational Method for Laminar Heat-Transfer in Channels, by H. C. Agrawal

60—WA-100 Fully Developed Pressure Drop in Triangular Shaped Ducts, by L. W. Carlson and T. F. Irvine, Jr.

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60—WA-193 Local Mass Transfer From Circular Cylinders in Cross Flow, by H. H. Sogin and V. S. Subramanian

60—WA-194 Axial Temperature Distribution for a Nuclear Reactor With Sinusoidal Space and Exponential Time-Varying Power Generation, by W. O. Doggett and E. L. Arnold

60—WA-197 Temperature Distribution in a Slab Moving From a Chamber at One Temperature to a Chamber at Another Temperature, by G. Horvay

60—WA-208 Experimental Ablation Rates in a Turbulent Boundary Layer, by E. P. Bartlett and M. R. Denison

60—WA-209 Oscillations in Two-Phase Flow Systems, by G. B. Wallis and J. H. Heasley

60—WA-210 Radiation Interchange in a Non-gray Enclosure Containing an Isothermal Carbon-Dioxide-Nitrogen Gas Mixture, by D. K. Edwards

60—WA-211 Unsteady Laminar Free Convection, by P. M. Chung and A. D. Anderson

60—WA-220 Buoyancy Effects in Forced Laminar Convection Flow Over a Horizontal Flat Plate, by Y. Mori

60—WA-232 Problems in Rating Severity of Exposures to Heat, by H. S. Belding and T. F. Hatch

60—WA-233 An Investigation of Porous Wall Cooling, by R. P. Bernicker

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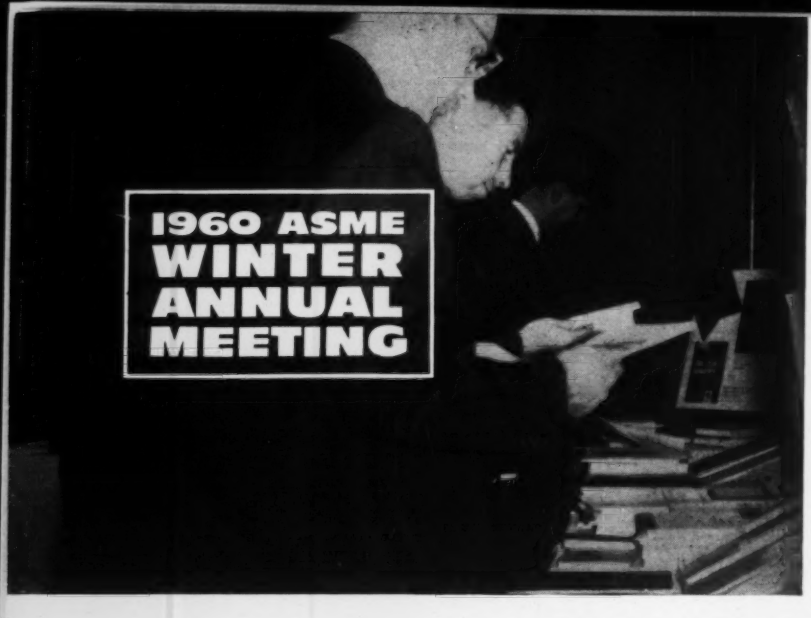

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COMMENTS ON PAPERS

Aircraft Seating

Comment by B. T. Fitchett[1]

THE general conclusion in this paper[2] is that forward-facing seats are stronger than rearward-facing seats, but passenger injuries are more likely to occur for forward-facing seats.

Also, little is known about nature of injuries in crashes. A test facility is proposed to (*a*) test actual seats under varying deceleration conditions—magnitude and duration; and (*b*) test human corpses to find out nature of crash injuries.

The real problem is ethical: How much weight penalty will the airline operators accept to safeguard their passengers during crashes that do not destroy the fuselage?

High-density coach seating demands rearward-facing seats. There is no point in having seats that stay in place if each one contains a battered passenger!

Finally, why do seats have to be cantilevered structures? The inviting vista of a clear cabin, with no ugly overhead seat braces, guards, or rails, may not be worth its cost in safety.

Author's Closure

Apparently, Mr. Fitchett believes that the injury curve of Fig. 5, in the case of forward facing with head strike, represents a true measure of injuries that may occur with forward-facing, high-density seats. The curve drawn in my paper is only hypothetical, based on the modest information I have. Mr. Fitchett may have additional information to support his view.

I. Irving Pinkel.[3]

[1] Design Engineer, formerly with Douglas Aircraft Company, Long Beach, Calif.

[2] I. Irving Pinkel, "Aircraft Seating—Forward Facing? or Rearward?" MECHANICAL ENGINEERING, vol. 82, February, 1960, pp. 60–63.

[3] Chief, Fluid System Components Division, Lewis Research Center, National Aeronautics and Space Administration, Cleveland, Ohio.

Fabrication by Explosives

Comment by John Pearson[4]

THIS writer is in general agreement with the author regarding the use of explosives applications in the metals industry, and the increasing scope of operation which such high-energy-rate techniques will offer in the near future. However, this is a young field with much of the current work being performed on an empirical basis. To help this field grow, a much greater interchange of detailed information is needed between the many groups operating in this area, as well as greater emphasis being placed on obtaining quantitative engineering data. The type of information that is needed badly includes: (1) A detailed understanding of the dynamics of the various operations; (2) data on the working parameters, i.e., type of explosive, charge size, standoff distance versus material properties, material thickness, size, depth of draw, and so on; and (3) data on the physical and metallurgical properties of metals after explosive working. This paper[5] appears to be a start in this direction.

As pointed out by the author, a large variety of metalworking operations can be performed with explosive charges. Although not specifically pointed out in the paper, both detonating explosives and deflagrating explosives are commonly used in these types of operations. Open and closed systems are both utilized. Working pressures range from only a few thousand psi to several million psi depending on the parameters of the operation. Basically, all of these operations can be placed in two categories: (1) Those which are classed as "standoff operations," where the charge is placed some distance from the workpiece and the energy transferred from the detonating explosive to the workpiece through an intervening medium such as water; and (2) those which are classed as "contact operations," where the charge is placed in intimate contact with the metal. Examples of standoff operations normally include sheet-metal forming, flanging, sizing, and the like. Examples of contact operations include controlled work-hardening, controlled cutting, some types of welding operations, and so on. Big differences occur between the pressures, times, and the material behavior involved in these two basic types of operations. Also, high-intensity stress waves are normally induced in the workpiece during contact operations and their effect has to be closely controlled.

In the paper, Fig. 1 indicates that explosive forming operations are performed in a time period of a few microseconds. It might be of value to the reader to point out that this essentially is true for contact operations with high explosives. However, for standoff operations with high explosives where a transfer medium such as water is used, and in low-explosive, closed-system operations, the forming time is measured normally in milliseconds or greater. Such forming times, as well as the corresponding metal-displacement velocities, have been measured at the U. S. Naval Ordnance Test Station by means of high-speed photography and special probe techniques. For example, in the free forming of a sheet-metal part with a high explosive the maximum displacement velocity for any part of the piece was found to be normally in the range of from 100 to 800 ft/sec, depending on the part size and depth of draw.

It has been our experience at NOTS that many of the techniques developed for the study of explosive ordnance and terminal ballistic problems are quite appropriate for studying various operations in the explosive working of metals.

[4] Head, Detonation Physics Group, Michelson Laboratory, U. S. Naval Ordnance Test Station, China Lake, Calif. Assoc. Mem. ASME.

[5] Vasil Philipchuk, "Fabrication by Explosives," MECHANICAL ENGINEERING, vol. 82, May, 1960, pp. 48–50.

The writer would like to suggest that such techniques be incorporated into industrial explosive metal-working programs such as described by the author in order to obtain the type of quantitative engineering data which is so badly needed.

Comment by R. A. Cooley[6]

The author's paper[5] is a good brief discussion of explosive forming of metals. I believe that he is the originator of the concept of using the constant K_m defined in his paper. This concept is interesting for generalizing purposes in explosive forming. However, I would like to see a complete description and discussion of the precise conditions under which K_m can best be measured. It would be interesting to compare the value of a K_m determined from the biaxial expansion of a tube or the expansion of a sheet into a trough with the triaxial expansion K_m of the subject paper. It appears that there are several possibilities of refining the K_m concept. If I understand the present conditions for measuring K_m, it would appear that additional factors such as thickness of metal, absolute size of specimen, strain rate, and so on might influence the experimental measurement. It would also be admirable to try to extend the use of K_m beyond a relative indication of the formability of metals to the prediction of the formability of metals into various classes of shapes. Also, it would be worth while to know the variation of K_m with temperature for various metals. Perhaps some day it will be possible to group metals according to their K_m value and then correlate the K_m value with crystal structure.

The fact that only seven values of K_m are given in the paper may indicate how young this characteristic of metals is and how many more data remain to be collected.

It would be helpful to hear a quantitative extension of the author's implication that it is "necessary to control the duration of the high stress applications to prevent failure" and an amplification of the statement that "there is a band of high stress-strain conditions which can be used for the successful forming of metals by explosive forces."

There may be exceptions to the author's broad statement that both hardness and ultimate strengths increase with explosive forming although there are several cases where this has been experimentally verified.

The importance of explosive welding merits considerably longer discussion than the one paragraph in the subject paper as does the compaction of powdered materials. However, this is one of the areas of explosive forming which is just beginning to receive attention and may eventually have significant effects on the powder metallurgy industry.

The author's suggestion for increased discussion between the design engineer and fabricating engineer before freezing of specifications certainly is well taken. It would be useful to have more specific information on his reference to savings achievable by proper design-fabrication-tooling combinations.

Comment by Alfred H. Petersen[7]

Results of the explosive-forming tests of Lockheed's California Division are substantially in agreement with several of the author's findings as reported in his paper.[5]

First, there is no question that the application of the wrong combinations of explosives and techniques to specific forming problems will often cause fracture of the material. Second, the distribution of pressure is highly important to the forming of complex shapes and even irregularly contoured tubular forms. The duration and velocity of the pressure wave are equally important.

It is not brought out, however, that explosive-forming shots in air generally are not successful simply due to the difficulty of spreading the pressure wave over the total area of the part to be formed and also of extending the duration of the wave over a sufficiently long period of time.

Unless explosive charges of extremely complex geometry are used, the wave is jet-like in form. The blank will shatter due to the high local elongations or it will not move since the velocity is so great that the inertia of the metal is not overcome until the pressure is dissipated. Hence no forming occurs.

As stated, the use of water serves to extend the pressure time and improve the pressure distribution. In fact, the energy release to gain a given result is only one tenth of that necessary in air, but this same reduction in energy also reduces the pressure to a point where results depend almost entirely on the ductility of the material as in conventional forming.

The author puts this concisely when he states that "The ability of a metal formed by explosives is a direct function . . . . of the per cent elongation." It follows, then, that annealed or otherwise relatively ductile materials will deform the most and the table in the paper should define the original condition of the materials that are listed before forming.

At working pressure from 100 to 1000 Ksi metals will behave as solids and plastic deformation occurs normally up to the point of fracture, even though the strain rate is extremely high. No transformations occur and the normal elongation is not exceeded as a general rule. These are the pressures found in explosive forming.

For pressures above 2000 Ksi, metals may be treated as incompressible fluids or liquids as in Bridgman's case, but this analogy cannot be used in explosive-forming work simply because we have not yet developed the system which will apply such equal or prolonged pressures.

The comments above apply for Lockheed's tests, which include the forming of cups, beads, and similar shapes from flat blanks. For these cases we have found only superficial work-hardening.

We have found no evidence of molecular bonding of dissimilar metals and attribute the degree of adhesion to the roughness of the surface and the relative softness of the materials. Products of forging tests have not evidenced the flow lines and directionality so important to achieving wrought properties.

In the field of bulging and expanding where parts are cylindrical or spherical in shape, explosive forming is finding its place as a satisfactory production method. Particularly in the aerospace industry, where exact tolerances are necessary, explosives can remove heat-treating and welding warpage and distortion much more readily and at less cost than conventional methods. The author's list of parts successfully formed would seem to support this opinion.

To conclude, until we learn to keep the pressure behind the shock front at a sufficient level to obtain complete forming, explosive forming is limited in application. We must also learn the effect and the control of wave interactions and reflections. It is only by understanding these conditions that we can move into the region of higher pressures and determine if metals can be treated as liquids so that hydrodynamic theories can be applied. Such an effort combined with the use of high temperatures may well change all our methods of fabrication and bring us broader design horizons and reduced costs of manufacture.

Author's Closure

John Pearson of NOTS, R. A. Cooley of Propellex, and Alfred Petersen of Lockheed have been kind in their discussion and I am in agreement with much of their comment.

In answer to specific equations in their discussion, my comment follows:

[6] Executive vice-president, Propellex Division, Chromalloy Corporation, Edwardsville, Ill.

[7] Group engineer, Production Design, Lockheed Aircraft Corporation, California Division, Burbank, Calif.

J. Pearson—no questions, no comment.

R. Cooley—(*a*) Refinement and additional factors for K_m factor. This work is needed and should be undertaken in order to better predict results on actual engineering jobs. American Potash funded the start of this concept while present efforts are directed mainly to actual parts fabrication. The effect of temperature, metal thickness, and the like would be most helpful to engineers.

(*b*) High stresses can be applied to certain metals and their duration controlled mainly in that the strain is stopped by a die. Actual stress strain used for forming parts falls in a region or band that will fracture a particular part.

Alfred Petersen—explosive forming operations are rarely conducted in air for the reasons Mr. Petersen states; hence I did not take time to describe air shots.

Metallurgical analysis of explosively welded specimens of dissimilar metals have been made for the Air Force and many of our clients. There is a metallurgical weld which consists of a fusion of the two metals, and this fused interface is usually harder than either metal.

Vasil Philipchuk.[8]

[8] Manager, Special Projects Department, National Northern Division, American Potash & Chemical Corporation, West Hanover, Mass.

Aerodynamic Heating

Comment by Alice M. Stoll[9]

This study[10] provides much-needed experimental data concerning the upper limit of temperature which may be tolerated in a closed environment. It provides, in addition, comparative data on the efficiency of various clothing assemblies in extending the protection afforded the individual by his own skin. It is remarkable how small the advantage provided by clothing really is when compared to that of the skin alone. In terms of temperature, it amounts to about 100 out of 500 F, or a 20 per cent increase, and in terms of time with the exception of the heaviest, most specialized equipment, it amounts to about 2 out of 8 minutes or a 25 per cent increase. However, these margins may well be significant in terms of engineering design and therefore should not be treated lightly. Furthermore, the specialized clothing fulfilled its purpose well in providing a 100 per cent increase in the tolerance time at 500 F even without ventilation of the suit.

The progression through sensory endpoints as criteria of thermal tolerance evidenced in part in the author's study is interesting. I believe that this is the first time that pain has been used as a criterion for total body heat tolerance. In the engineering field of heating and ventilation, much effort has gone into the delineation of the comfort zone or, to put it another way, the zone of neutrality of sensation. In the narrower field of calorimetry the comfort zone has been flanked by the zones of Newtonian cooling, and of vasomotor temperature regulation on the one side and of sudomotor temperature regulation on the other, all distinguished by the sensory endpoints of cold and warmth. The present work fits into a zone of total body heat tolerance demarcated by pain sensation, and just preceding the ultimate region of heat exhaustion which has been studied quite thoroughly where giddiness, nausea, and cardiac palpitation provide the sensory signals of impending collapse. This is a most impressive spectrum worthy of the many labors required to piece it together bit by bit.

In the interest of contributing as much as possible to the completeness of the picture, it might be well to compare more particularly the present data with the UCLA data to find the point at which they merge. If sufficient data are available on air and wall temperature and air movement within the chamber, such a comparison might be possible through the use of the concept of operative temperature.

I would like to ask the author whether or not he has attempted a comparison in this fashion. If so, what was the outcome, and if not, does he think this procedure is feasible and worth while?

Comment by K. J. K. Buettner[11]

The author of this paper[10] has made a realistic approach to a frequent nightmare. The question: "How bad is heat of the range 300 F and more?" struck me first while investigating consequences of airplane crash fires and of city conflagrations. These investigations led to the discovery of the 45 C skin-pain point and the invention of the aluminum-coated fire protective suit. I see with pleasure the use of these two results of my former research. Also, long ago, I exposed myself to 400 F for about two minutes. The clothed parts of the body felt no heat, whereas the bare face felt hot and showed first and second degree burns on the nose. I am happy to hand over this rather unofficial world record to the author. If a certain deduction is made for the not constant temperature in his data, they fit quite well in the over-all picture as given at the ASME Semi-Annual Meeting in 1957 (ASME Paper No. 57—SA-20). (See Mechanical Engineering, November, 1957, vol. 79, pp. 1031–1032.—*Editor*.)

In future tests, conditions of test persons before heat exposure should be varied: They should be chilled to the lower comfort level, normal, and sweat covered. In my 400 F experiment it seemed vital that the face was wet from heavy sweating caused by previous exposures to less severe heat. On the other hand, precooling of an arm prolonged exposure time to radiant heat more than two times.

Author's Closure

Miss Stoll has put my report in nice perspective, relating it to the general spectrum of human thermal tolerance. I believe she is right in saying that this is the first time experiments have been done using surface pain as an endpoint in high-temperature exposure. Mild heat exposure, lasting several hours, may terminate finally from fatigue. More severe exposures, such as studied at UCLA, terminate from excessive storage of heat in the body. The very high-temperature exposures terminate much sooner. The endpoint is quite real. Staying longer than the times shown produces skin burns.

It should be pointed out that the difference between an exposure increasing to 400 F and one increasing to 500 F at terminus is a large one. Protecting the surface with light clothing is subjectively quite significant. I don't think one can use a percentage term. Zero degrees F does not represent some kind of physiological zero point; I do not quite know how to handle the notion of a percentage of degrees F. On the other hand, a percentage increase in time for a given thermal transient is a valid way to compare. It is quite true that light clothing increased the time of exposure by approximately 25 per cent over the nude exposure.

Finally, the direct question concerning comparison with previous data from UCLA, in which the body storage of heat-set limits to heat exposure, has been considered. With newer data, not available at the time of this report, one begins to see the transition between body

[9] Acceleration Laboratory, U. S. Aviation Medical Naval Air Development Center, Johnsville, Pa.

[10] Paul Webb, "Aerodynamic Heating," Mechanical Engineering, vol. 82, June, 1960, pp. 60–62.

[11] Professor, Department of Meteorology and Climatology, University of Washington, Seattle, Wash.

storage and pain-limited exposure at about the 250 F level. (In this comparison the air and wall temperatures are equal and the air movement is minimal.) It even appears that there is a transitional region in which body storage is building up but pain limits the exposure; or conversely, body storage builds up and pain is minor enough that a trained subject can persist until his body storage limit is reached. A more exact definition of this region will have to await a subsequent report. The suggestion is well taken.

Dr. Buettner's comments are certainly appropriate. We are all aware of his pioneering contributions in the field of very high-temperature exposure. The direct suggestions of using precooled subjects and those subjects who are already heated, vasodilated, and sweating, are interesting ones. I know of some preliminary, unpublished work done at the Aero Medical Laboratory, WADC, in which subjects were precooled to mean skin temperatures of about 80 F, then exposed to thermal transients similar to those in my report. I believe the increase in tolerance was only minor. The pain limit came on quite rapidly again.

Perhaps if the heat were abruptly applied, instead of increasing steadily from comfort level, the precooled skin would have shown greater tolerance to a given extremely hot condition.

Apparently the surface of the skin heats quite quickly, with less lag than one would anticipate if the "skin" were several millimeters deep. So far, all of our experiments have avoided the use of subjects previously exposed to heat. Sweated and flushed subjects probably would last a little longer, or to a slightly higher temperature, both from the cooling effect of evaporating sweat and the greater carry-off rate of the well-irrigated skin. How much effect there might be from the presence of water droplets, I would not care to guess. The thermal inertia of the skin is important in these exposures. Perhaps the presence of water drops on the skin would improve the situation.

Paul Webb.[12]

[12] Medical Doctor, Webb Associates, Yellow Springs, Ohio.

The Low-Level Economizer: The Problem

Comment by E. S. Monroe[13]

I wish to thank the author of this paper[14] for his excellent presentation; primarily because I have been trying to arouse interest in building a simple and more efficient industrial steam-generating station for some time.

Picture, if you would, an industrial boiler installation where *all*, not 80 per cent, of the steam produced is piped away to the process. The feedwater piping, deaerator, and feedwater pumps do not require insulation. All auxiliaries are electrically driven. Only the blow-down piping requires insulation at the operating level.

Such a simplified, and possibly automated, station is possible with a low-level economizer and the application of vacuum deaeration of the feedwater.

The writer's company, The Green Fuel Economizer Company, Inc., made a paper study of building such a plant with an export capacity of 100,000 lb per hr of steam, and compared it with a more conventional unit equipped with steam and electric auxiliaries, 15-lb steam deaeration, and no heat traps. This study was carried out in detail to reflect engineering time, allocated investment in pumping equipment, electrical services required, fuel-oil storage changes, and so forth. The flue gases were made to skip contact with surfaces that we considered to be in the danger zone. It was found that the proposed plant cost 5 per cent more than the conventional design, but that a gross reduction of 6 per cent of the operating costs could be achieved, despite the use of more expensive electricity to drive the auxiliaries.

Such a system lacks, however, one prerequisite for a satisfactory installation stipulated by the author for oil and gas-fired units. It has no simple way of controlling the economizer temperature between 140 F and 220 F. What is the reasoning for these limits? He advocates "Safe-Dangerous-Safe-Dangerous" corrosion zones as the flue-gas temperature is lowered. I readily agree that undoubtedly we have been operating units unknowingly in the upper dangerous zone and that its existence is well established. The seriousness of the lower dangerous zone is not so clearly established, and the work of Piper and Van Vliet of Detroit Edison[15] on several specimens would indicate that the theorem of acid mist sweeping out of the unit prior to copious condensation is not entirely correct. In questioning the existence of the lower zone of danger for cast iron, here are some excerpts from a letter from Monsieur F. Calvez of the Group for Thermal Production of the Paris region of the Central Electric Board of France. This letter describes the operation of a low-level economizer over a period of five years of operation. This unit operated successfully in the most dangerous zones and with the worst fuel predicted by the author.

"Boiler No. 43 was equipped in November, 1952, with a Green economizer with horizontal tubes and water washing to experimentally test the effect of leaving flue gases at lower than normal temperatures.

"At the time of shutdown (March, 1958) of the Station (St. Ouen), No. 43 boiler had 15,000 hr of service with the economizer in place and had been started and stopped 425 times, 37 times from a totally cold boiler.

"The time on the line at full load was 5000 hr and at half load about 2800 hr.

"The working conditions for the economizer at full load were: Feedwater flow 80 tons/hr (boiler pressure 20 kg, superheat temperature 330 C): The temperature of the water entering the economizer averaged 104 F and 248 F leaving; the temperature of the flue gas to the economizer averaged 625 F entering and 214 F leaving.

"At a load of 37 tons/hr, the average water-inlet temperature was 104 F, leaving was 235 F, and for the gas 493 F entering and 165 F leaving.

"This economizer was washed downward with raw water through transverse sprays at a rate of 40 tons/hr for ten minutes twice a week.

"It was measured to determine the amount of corrosive wear on the coldest tubes (entry of water, leaving of gas) and found to be 1 mm after 4700 hr of operation (average of 36 measured points). The wear was measured at 2.75 mm after 15,000 hr of operation."

It is suggested that if we expel acid mist at low temperatures from stacks that we are doing the cause of atmospheric pollution no good. On the other hand, an acid-condenser that pays for itself may be something unique in this field.

[13] Engineering Service Division, E. I. du Pont de Nemours & Co., Inc., Wilmington, Del. Mem. ASME.

[14] Stan Jewson, "The Low-Level Economizer: The Problem," MECHANICAL ENGINEERING, vol. 82, June, 1960, page 65.

[15] J. D. Piper and H. Van Vliet, "Effect of Temperature Variation on Composition Fouling Tendency and Corrosiveness of Combustion Gas From a Pulverized-Fuel-Fired Steam Generator," ASME Paper No. 57—A-281.

In conclusion I should like to ask the author four questions.

1 What proof do you have of the acid mist theorem?

2 Since spreader-stoker-fired boilers have high dust loading and are quite susceptible to economizer and air-heater corrosion, how does this fit in with your theory on nuclei forming the acid mist?

3 How do you account for the successful operation of a low-level economizer described in your paper in the zone you predict as most dangerous?

4 What increase in atmospheric pollution problems do you predict with lower flue-gas temperatures?

Comment by M. J. Archbold[16]

The author is to be congratulated upon writing a concise and clearly worded paper[14] covering the use of the low-level economizer. The paper covers the possible problems to be encountered in its use; such as the circuitry, corrosion, construction, and water washing. This paper should give the electrical industry renewed confidence in a device which can be instrumental in low-temperature heat recovery. This results in an improved heat rate and, therefore, a savings in the operating costs of the unit.

The Commonwealth Edison Company has made three attempts to work this device into their system and each attempt has proved unsuccessful. Several of the items which contributed to the failure to prove the economizer in were, namely, the high cost of the economizer itself, the high cost of the system devised for its use, and the cost of ammonia which we had considered necessary to neutralize the SO_3.

Since that time our further studies have given us a much better feel for this problem. We do not have the fear that we previously had of the corrosion, and we believe that the reduced temperature of the stack gases will not materially increase the downwash of the plume.

The recent change in the design of the economizer tube has greatly reduced the economizer cost. The elimination of the need for the use of ammonia and renewed confidence which we have for the reliability of this device have encouraged us to make a fourth study. This study has shown the economizer in a much more favorable light, and it is our belief that it will now be a good investment. It is now being considered for one of our next units.

[16] General mechanical engineer, Commonwealth Edison Company, Chicago, Ill.

Comment by J. H. Potter[17]

We are much indebted to the author for this excellent paper.[14] It serves to explain the design features of the cast-iron low-level economizer and to indicate several areas of application.

His lucid explanation of the corrosion problem is especially welcome. The graphic presentation of the flue-gas corrosion zones (Fig. 1 and Fig. 2) is most helpful, as is his reiteration of the probable function of fly-ash particles in the protection of heat-transfer surfaces in boiler plants using pulverized coal. The information on washing procedures is most interesting.

At present, low-level economizers are in use in both central stations and industrial power plants. For the most part, the units are used to replace steam tempering coils, although at least one low-level economizer is being used to replace a feedwater heater.

It is unfortunate that the word "economizer" has been applied to this low-level heat-recovery device, as some confusion has been encountered between the low-level economizer and conventional water-heating device in the steam-boiler circuit. It would be better if a new name could be found which would specifically identify this new device.

It is predicted that in the future flue-gas temperatures will be reduced even further. It is hoped that ceramic or other protective coatings may be developed so that the extended surfaces will be able to operate in the highly corrosive regions.

Author's Closure

The author appreciates the comments of Messrs. Monroe, Potter, and Archbold. Mr. Monroe concedes the presence of the upper sulfuric-acid corrosion zone, but questions the seriousness of the lower corrosion zone and also questions the "safe zone" limits between 140 F and 220 F.

All sulfur-bearing fuels produce SO_2 in the products of combustion. In addition, the products of combustion contain considerable water vapor formed by the combustion of hydrogen plus the moisture contained in the fuel and combustion air. On cooling the flue gas below the water dew point, the water vapor present will condense out on cool surfaces. The free moisture formed will readily combine with SO_2 in the flue gas to form highly corrosive sulfurous acid.

If chlorine is also present in the fuel, the chlorides formed by combustion also will combine with the free moisture to form hydrochloric acid. The afore-mentioned reactions are confirmed by Jenkinson (ASME Paper No. 56—A-184), and by Piper and Vliet (ASME Paper No. 57—A-281). The latter states "condensate will drip from cooled metal surfaces in stack gases, even 'cleaned gases,' only if the metal temperature falls below 105 F and remains below that temperature for sufficient time for drops to accumulate. Such condensate is extremely corrosive."

The "safe zone" limits for oil firing are selected to provide a margin of safety above the water dew point, and below the sulfuric corrosion zone. The lower limit also allows for an increase in the water-dew-point temperature caused by increased amounts of water vapor in the stack gases.

The acid-mist theory (Jenkinson, ASME Paper No. 56—A-184), put forward to explain the upper corrosion zone and why this zone is relatively unimportant with pulverized coal firing, is at the present time the only satisfactory explanation of all the results obtained in practice. Until such times as this theory can be disproved it should surely be upheld.

The dust loading on an average pulverized-coal-fired boiler is usually about 50 per cent higher than the dust loading of an average spreader-fired unit. However, the actual weight of fly ash present in the flue gas is not the prime consideration. The pulverized-coal fly ash contains a high percentage of fine particles which have a high total surface area per unit weight and are therefore capable of condensing considerably more acid than an equal weight of coarse particles. In addition, the author pointed out in his paper that pulverized-coal fly-ash particles are usually basic in nature and therefore tend to neutralize acid which settles upon them. This is not usually true with other types of firing and the reverse is often the case.

The author would point out that his paper[14] did not refer to any specific installations but merely discussed the possibilities of using cast-iron heat exchangers as a means of recovering heat from temperature zones which were hitherto considered dangerous.

The author is quite familiar with the Green economizers installed on Boiler No. 43 at the St. Ouen Power Station of the Electricite de France. This economizer should not be described as a low-level economizer in the strictest sense, since it does have a conventionally high inlet-gas temperature. However, the author concedes that this unit does have an exceptionally low exit-gas temperature and it has provided the industry with much useful operating data for oil-

[17] Dean of Graduate Studies, Stevens Institute of Technology, Hoboken, N. J. Mem. ASME.

fired units with low-temperature back-end surfaces. Incidentally, the St. Ouen economizer was one of the first units of its type to employ on-load washing as a means of cleaning the economizer surface. This unit employs cast-iron extended surface tubes. The temperature gradient across an extended surface-type tube is much higher than a plain tube, and consequently it is possible to maintain a given minimum tube-metal temperature with lower temperature inlet water. The author stressed that the temperatures given in his paper were metal temperatures and not water temperatures.

The information given by Mr. Monroe, on the behavior of the St. Ouen economizer, while not erroneous is certainly misleading. The unit has been operated over a five-year period but only as a peak load unit during the winter months, as evidenced by the low load factor given by Mr. Monroe. The data given by Mr. Monroe contain only water temperatures and do not give the corresponding metal surface temperatures with which to compare it with the "safe" and "dangerous" zones stated by the author. However, given later, is a more complete report on the St. Ouen economizer which the author received from the Green Company in France. The report is dated January, 1959.

Top row of tubes—water temperature 248 F. (*a*) External diam of tubes reduced to 86–87 mm. (The temperature of the tube body is in the upper corrosion zone.) (*b*) Condition of gill tips—no corrosion. (Gill tips above upper corrosion zone.)

Middle row of tubes—water temperature 151 F. (*a*) External diam of tubes 90 mm—no corrosion. (The tube body is in the safe zone.) (*b*) Condition of gill tips—gill tips like knife blade. (The gill-tip temperature must be in the upper corrosion zone.)

Bottom row—water temperature 104 F. (*a*) External diam of tubes between gills 82 mm. (The temperature of the tube body is in the lower corrosion zone—considerable corrosion.) (*b*) Condition of gill tips—slightly corroded. (Temperature may be near water dew point.)

This report clearly demonstrates the presence of both corrosion zones with the intermediate safe zone mentioned by the author in his paper. Although the corrosion described by Mr. Monroe does not appear to be serious, if this unit operated continuously over the five-year period, it would by this time be a total loss. The author therefore would not regard this unit as "operating successfully," but rather as a good example of the effects of sulfurous and sulfuric-acid corrosion.

Stan Jewson.[18]

[18] Manager, Heat Transfer Division, The Green Fuel Economizer Company, Inc., Beacon, N. Y.

Photoelastic Model Engineering

Comment by R. A. Thomson[19]

THE authors of this paper[20] have implied that solutions exist for certain of the problems of technique which arise in the application of the photoelastic method. The writer believes that references or more details in this regard would be desirable, in particular for controlling the time effect in epoxies, and for producing smooth and reasonably stress-free cast surfaces in these materials.

The improvement in stress distribution produced by using a nut with a tapered skirt, Fig. 4, has previously been reported by Hetényi.[21] Also, the issue has been confused in the authors' study by the fact that the design of the threads as well as the body of the nut was changed, making it impossible to determine what portion of the improvement in stress distribution was due to changing the thread form.

In the interest of completeness, it might be pointed out that in the 1950's the previous work in the production of three-dimensional photoelastic models was brought to its complete fruition through the work first of Frocht and Guernsey,[22] followed by Frocht and Srinath,[23] in which methods were developed for obtaining complete three-dimensional stress distributions without destruction of the model.

Page 45, second last paragraph, contains a typographical error in which "dissembled" has been printed for "disassembled."

Comment by Edgar C. Clark[24]

The authors of this paper[20] have emphasized the need for precision in the manufacture of models for use in three-dimensional photoelastic analysis. This precision is a requirement of the scale ratio, and not the method of model analysis used. They make no mention of the tedious chore of point-by-point measurements of isoclinic angles, and exact isochromatic fringe values, and the work of reducing these values to resultant principal stresses. It might be pointed out that if you are going to do this careful analysis of stresses at interior points in the model, every photoelastic laboratory should have in addition to its precision machine shop, an IBM 704, Burroughs 220, National 304, or a Univac to take over this time-consuming computation. In practice, access to one of these computers will suffice.

If stresses were not computed in the interior of the model, the biggest advantage of the photoelastic method is not fully utilized. The model could have been made of some other material, and stress coat, photostress, or strain gages used to measure the surface strains. Even for models in which the complete photoelastic procedure is not used, the use of epoxy or other resin for the model material has the advantage of low modulus; which means large and easily measured strains at low loads. In addition, the stress-freezing possible with a suitable photoelastic material makes it possible to "read" the results of the test after the load has been removed. This has a concurrent disadvantage, namely, that this can be done for one load level only, since the model must be sliced before doing this stress measuring, and so no longer exists as a model.

The authors also point out the need for experience in doing this model slicing and fringe evaluation. As a teacher, I am concerned about where the next generation of stress analysts is going to get this experience. While it is not mentioned in the paper, it might be assumed that the Research Division of the College of Engineering, New York University, where these projects were successfully carried out, employs students, either graduate or undergraduate, on projects such as this, so they may be learning while doing. But not all engineering students attend New York University, nor could they! So it is with some concern that I examine the facilities at certain other schools, such as my own,

[19] Assistant professor of engineering mechanics, University of Dayton, Dayton, Ohio. Mem. ASME.

[20] Herbert Becker and George Gerard, "Photoelastic Model Engineering," MECHANICAL ENGINEERING, July, 1960, vol. 82, pp. 43–46.

[21] M. Hetényi, "A Photolastic Study of Bolt and Nut Fastenings," Trans. ASME—*Journal of Applied Mechanics*, vol. 10, no. 2, June, 1943, pp. A93–100.

[22] M. M. Frocht and R. Guernsey, Jr., "Further Work on the General Three-Dimensional Photoelastic Problem," Trans. ASME—*Journal of Applied Mechanics*, vol. 22, no. 2, June, 1955, pp. 183–189.

[23] M. M. Frocht and L. S. Srinath, "A Non-Destructive Method for Three-Dimensional Photoelasticity," Proceedings of the Third U. S. National Congress of Applied Mechanics, 1958.

[24] Professor of mechanical engineering, Ohio State University, Columbus, Ohio.

not fortunate enough to have available all the equipment required for this type of research, and perhaps not even having a Division of Research to bring together such equipment. Fortunately, all is not lost. Any small Experimental Stress Analysis Laboratory which has a polariscope can give its students experience with two-dimensional photoelasticity, which is the first steppingstone to three-dimensional methods. Flat polished plates of photoelastic material are readily available commercially, and two-dimensional models may easily be produced, perhaps with an assist from the school's machine shop.

I, for one, would like to be able to introduce our students to the stress-freezing technique. To that end I have been examining a variety of casting resins and their catalysts in a search for a photoelastic casting resin which will: (*a*) Require little or no heat for curing, and (*b*) will have a relatively low critical temperature at which to freeze in the stress patterns. One of the chief drawbacks of working with large models has been the size of the oven required for the stress freezing and the attendant complicated mechanism necessary to control the temperature at all times, and to reduce the temperatures gradually enough to keep a uniform temperature gradient throughout the model. My approach, since we have no sponsored projects such as these described, has been to keep all models used for teaching purposes small, so that this rate of control is not so critical. I have modified a small commercially available oven, $12^1/_2 \times 12^1/_2 \times 12$ in., so that load may be applied to specimens inside the oven by a lever-loading system entirely outside the oven, plus a plunger which enters the oven through the former thermometer opening in the top.

Safety in Materials Handling: Safe Conveyers

Comment by R. C. Sollenberger[25]

THE author of this paper[26] has presented his case so well that I have no quarrel either with his statements nor his conclusions. I would like to emphasize the fact that industry and commerce can no longer afford the luxury of avoidable accidents, and most accidents can be avoided through the combined use of recognized safety devices and plain old common sense. If your workmen do not have the latter, no amount of safety precautions will prevent accidents.

My organization offered a short feature article last summer on the subject, "Plant Safety—Everybody's Job," and within three weeks after the announcement we had received requests from more than 450 trade papers and company publications. The secret behind this demand was simply a listing of ten "common sense" operating tips for employees who work with or service conveyers.

The author makes similar points in his paper and goes beyond operating tips by describing provisions of the Safety Code, B20.1–1957, which deals largely with construction and installation practices. He points out that, while conveyers in themselves serve to prevent accidents, they can be dangerous if misused or if common sense precautions are not taken. Even so simple a tool as a screwdriver can be dangerous if not properly used, or if not shown the proper respect. I know this from personal experience, for the lowly screwdriver is the only tool with which I have suffered injuries.

The Conveyor Equipment Manufacturers Association played a major role under the leadership of the author in developing the present Safety Code for "Conveyors, Cableways, and Related Equipment," and we believe that it was well worth some effort on our part to bring it before the attention of industrial engineers and safety officials.

Last winter we surveyed safety officials in all 50 states and two territories to see what safety measures they had on their law books and to see what influence B20.1-1957 might have.

Of the 52 agencies surveyed we found that 47 had no safety regulations applying specifically to conveyers. Four said that conveyers were named and nine replied that they applied general machinery safety rules. In all, 31 reported that they used B20.1-1957 as their guide. One, Maryland, refers to B20 in the state code thereby giving it the status of a state law.

Of the 52, we received requests from 43 for copies of the code and some ordered extra copies. Florida asked for 25 to be distributed throughout the state. At this time, however, all 52 safety agencies have copies of B20 in their files. Many states sent us copies of their statutes, either specific or general.

Since that time, we have had an opportunity to place copies in the hands of some 20 or more municipal safety men. As future opportunities arise, more copies will be placed in the hands of additional safety men.

We have suggested to conveyer manufacturers that they state that their equipment is built in accord with the provisions of B20 and that each spread the distribution of the code whenever a chance presents itself.

The American Society of Mechanical Engineers is performing a great service to industry and commerce through its sponsorship of the many codes and standards which find approval through the established procedure of the American Standards Association as "American Standards" and finally achieve International status through ASA's work with the ISO.

I am sure that the author will agree with me when I say that ASME standards deserve even more recognition than they have gotten. ASME members of appropriate Divisions could and should constitute a strong force for the wide dissemination of safety and product standards produced under the Society's sponsorship. The goal stated in the author's original title, "Materials Handling Without Accident," should not be difficult to reach when safety becomes "Everybody's Job."

[25] Executive vice-president, Conveyor Equipment Manufacturers Association, Washington, D. C. Mem. ASME.

[26] J. C. Webb, "Safety in Materials Handling: Safe Conveyers," MECHANICAL ENGINEERING, July, 1960, vol. 82, pp. 34–35.

A Turbine-Testing Facility

Comment by J. K. Dixon[27]

The turbine-test facility described in this paper[28] is certainly one which can provide a great deal of useful data in several important areas of steam-turbine design. The need for "eternal vigilance" in the planning, maintenance, and calibration of the basic instrumentation as cited by the authors can hardly be overemphasized for a test facility of this type. The calibration of dynamometer weights on the flow-weighing scales and the use of the same time interval for counting revolutions and weighing flow are ingenious. However, some questions concerning both testing technique and the results occur to the writer and comments by the authors are solicited.

First, regarding testing technique, it is stated that a variation of ±20 rpm may occur during the test interval. It seems to the writer that a consequent variation in dynamometer torque would exist. If so, is there some means for averaging the torque over the test interval?

[27] Development engineer, Steam-Turbine Department, Allis-Chalmers Manufacturing Company, Milwaukee, Wis. Mem. ASME.

[28] C. A. Meyer, C. E. Seglem, and J. T. Wagner, "A Turbine-Testing Facility," MECHANICAL ENGINEERING, July, 1960, vol. 82, pp. 47–52.

Secondly, it is indicated that bearing loss in the test facility is determined from bearing-oil temperature rise and oil flow. Deceleration tests on an experimental turbine at the writer's company have shown higher losses than those calculated from bearing-oil temperature rise, the difference being assignable to heat conducted into bearing pedestals. Have the authors taken this into account?

As regards vibration in low-pressure exhaust blades, the authors state that resonance of a higher mode of vibration with the nozzle passing frequency has been found to be an important cause of vibratory stress. Some work currently in progress at the writer's company tends to confirm this observation. Has it been found possible to identify such a resonant mode, either experimentally or by theoretical means?

Further on this same matter, the authors indicate from the oscillograms shown in Fig. 12 that a considerable reduction in vibratory stress at nozzle resonant frequency (30th harmonic) was effected by a redesign of the stationary blades in the preceding row. This redesign, as shown in Fig. 5, apparently involved an increase in the number of stationary blades. Yet the oscillograms compared in Fig. 12 appear to exhibit the same frequency. If the number of stationary blades was increased, would not the nozzle passing frequency likewise increase; and would not this new frequency be of primary importance in determining the stress magnification due to possible resonance?

Comment by F. H. Light[29]

The authors of this paper[28] are to be commended for a fine presentation of their subject. The results of their efforts are of considerable importance to the electric-utility industry which is continually seeking more efficient and reliable turbine designs.

Tests of new reheat turbines placed in service on the Philadelphia Electric Company system during the past six years have indicated that deficiencies from expected performance have been due mainly to poor performance of the low-pressure section of these turbines. Of five such turbines tested, the over-all heat rate has ranged from zero to 1.3 per cent over expected at rated load. Improved low-pressure turbine-blade design seems to be the answer to this problem.

Experience With Redesigned Low-Pressure Blades. Two Westinghouse units on the Philadelphia Electric Company system were modified by replacement of the last two stages of stationary low-pressure turbine blades with redesigned thin section blades. Delaware No. 8 Reheat Unit (125 mw) tested 1.3 per cent poorer than expected before modification and was improved 0.5 per cent after modification. However, the initial tests were based on boiler feedwater as the basic flow, while the tests after modification were based on condensate flow; if boiler feedwater had been used for both test series, an additional improvement of 0.8 per cent in heat rate is indicated. Not all of this improvement can be credited to blade replacement since other modifications were made during the overhaul, but the blade change was a major factor in effecting better performance. Cromby No. 2 Reheat Unit (200 mw) was also modified in a similar manner. Tests following the modification indicated an improvement of 0.3 per cent. In this case the blade modification was the only major change affecting the turbine heat rate.

Conclusion. These two cases show positive gains which are of appreciable value on base loaded units. Further research to produce better blade designs should be encouraged. Our company is ready to co-operate in field tests to expand the scope of a laboratory research program.

Authors' Closure

The authors wish to thank Messrs. Dixon and Light for their comments. Mr. Dixon questions the effect of speed variations on torque measurements. It has been observed during test that these small speed variations cause simultaneous variations of torque, and thus the power output, which is the product of speed and torque, is essentially constant.

Data readings of torque and speed are recorded simultaneously every two minutes during a test run and then averaged over the test interval. This is sufficient to meet the test-accuracy requirements. In regard to bearing losses the facility design incorporates no bearing pedestals in the usual sense. There has been no evidence of significant heat-conduction effects on the measured bearing losses.

The principal bearing loss is that of the thrust bearing and the independent measurement of its loss by torque-load cells indicate good agreement of the two methods. The temperatures-rise method is more consistent. Sealing steam in the gland tube on the brake-end turbine bearings contributes some conducted heat gain to the journal bearings, but the over-all effect of this on performance is small (the journal bearing losses are $^1/_2$ per cent at the turbine full load point so measurement errors of the journal-bearing losses are negligible).

Mr. Dixon correctly points out that in the paper[28] only Fig 12(*a*) shows thirtieth harmonic nozzle-resonance vibration. After the increased number of redesigned stationary blades was installed, no significant nozzle-resonance vibration was observed. Fig. 12(*b*) actually shows the thirtieth harmonic vibration which still occurred at the same speed and to the degree illustrated. Though the same mode of vibration was excited, it is no longer a nozzle resonance phenomenon.

It presumably was excited in the same manner as vibration in the lower harmonics.

The authors also agree that the increased nozzle-passing frequency would be important if a corresponding high-frequency mode were excited significantly.

In regard to the identification of the mode of the nozzle-resonance vibration, tests have revealed a group of modes in this frequency range. In all these modes, the tip portions of the blades, beyond the outer lashing wire, behave much like a uniform cantilever beam vibrating in the second mode. The frequencies are also in the same range as the second mode of a cantilever assumed fixed at the outer lashing wire.

Mr. Light's comments call attention well to the important economic gains to be realized by improved low-pressure turbine blading. The test results on the units mentioned were in general agreement with the performance gains expected from installation of redesigned stationary blading only, as shown in Fig. 7 of the paper. Applying the complete redesign of both rotating and stationary blading would offer an additional substantial performance gain.

The Philadelphia Electric Company, through Mr. Light, pioneered in permitting some of the first low-pressure turbine pressure probe traversing to be made, and these data were valuable in bringing about the design changes and improvements he mentions.

C. A. Meyer[30]
C. E. Seglem[31]
J. T. Wagner.[32]

[29] Senior engineer, Economy Division, Philadelphia Electric Company, Philadelphia, Pa. Mem. ASME.

[30] Advisory engineer, Westinghouse Electric Corporation, Lester, Pa. Mem. ASME.

[31] Supervisory engineer, Westinghouse Electric Corporation, Lester, Pa., Assoc. Mem. ASME.

[32] Development engineer, Westinghouse Electric Corporation, Lester, Pa. Assoc. Mem. ASME.

Notes on Books Received in Engineering Societies Library

REVIEWS OF BOOKS

Dynamic Management in Industry

Dynamic Management in Industry

By Raymond Villers. Prentice-Hall, Inc., Englewood Cliffs, N. J., 1960. Cloth, 5½ × 9 in., figs., reading lists, bibliography, index xi and 516 pp., $10.

Reviewed by Lillian M. Gilbreth[1]

AT A TIME when Management is being evaluated, and when the Management Division of ASME is celebrating the Golden Jubilee of Scientific Management, a textbook like this one by Professor Villers seems especially timely and useful. A veteran teacher and consultant, the author has put his experience and wide reading into a form that makes it possible for the student in a college or university and also for a student in the "Life Long Learning" category, who is working by himself, to take up the challenging process of checking and supplementing what he already knows.

He will start, as he reads this book, with a Table of Contents that tells him that the past, present, and future of Management is to be discussed. The material covering the past includes not only accounts of the pioneers and their contributions, but valuable quotations from those whose writings are hard to find. The reader will become acquainted with the plan of the book—each of the 15 chapters being followed by "Suggested Readings for Selected Topics." He will find carefully documented footnotes, so that each chapter is a complete lesson—introduction, presentation, review.

These comments do not do justice to the breadth, depth, and variety of the material in the book. We get information, evaluation, stimulus to read on—an urge to test and use what we have studied.

It should be noted that reference material consists largely of writings during the past ten years and that not only books but articles in management magazines and other periodicals are included.

In some ways the book seems like a handbook. On first reading one needs to read steadily, if possible, from beginning to end. This is a rewarding experience! Then it may be reread as a whole, or chapter by chapter, or section by section, to bring one up to date when one needs to be.

A "Selected Bibliography" at the end of the book, listing both by authors' names and by management functions, and a carefully prepared Index make it easy to locate the reference material.

Naturally, even such an encyclopedic book cannot contain everything one might hope to find included in it. One could wish for more material on small industry, especially as this would be useful in the newly developing countries in the thirty plus groups who are members of CIOS—our International Management Organization—and to the other countries which will join CIOS when they are able to do this.

One could wish also, though perhaps this may require a second volume, reference to the literature of the CIOS member countries—both that which is appearing in English and in other languages.

In the meantime we can supplement the book with the many fine publications that come in, like the CIOS "What Is Being Done in the Management Movement," which gives so much in so little space, and into the varied large, small, simple, elaborate papers and magazines which some of us enjoy and appreciate, from countries we have visited or hope to visit.

And to these we can add Professor Villers' book to our close-at-hand reference shelf, ready to be consulted when we need his freely offered help.

[1] President, Gilbreth, Inc., Montclair, N. J. Hon. ASME.

BOOKS RECEIVED IN LIBRARY

Fundamentals of Engineering Drawing

By Thomas E. French and Charles J. Vierck. 1960, McGraw-Hill Book Company, Inc., New York, N. Y. 115 p., 8½ × 9½ in., bound. $7.50. A shortened, combined version of two long-standing "classics" by the same authors, this text contains the elements of graphics necessary in engineering. It covers shape description, including instruments and their use, applied geometry, lettering, orthographic and pictorial drawing and sketching, sections, views, and conventions; size description; and the elements and techniques of working drawings. In addition to the usual illustrations and problems a considerable amount of reference material is provided.

A History of Metals

By Leslie Aitchison. 1960, Interscience Publishers, Inc., New York, N. Y. 2 vol., 9 × 11¼ in., bound. $30. The author relates the history of metals from the later stone ages to the age of nuclear fission, with the discoveries of new metals, processes, alloys, and uses throughout the ages. Of interest to historians and archaeologists as well as to metallurgists, the work is not a history of technical procedures, but is rather an account of the uses and processes of metals technology in its historical perspective. The first volume covers the seven earliest known metals, the alloys known in antiquity, and methods of processing them before machines were used. The second volume describes the revolution effected by machine power and exploration to uncover and eventually to create new metals and to provide more effective processing methods for metallic materials.

Hütte: Maschinenbau, Part B. 28th Edition

Published 1960 by The Verlag von Wilhelm

Ernst and Sohn, Berlin, Germany. 930 p., 5 × 7¼ in., bound. DM 48.00. The mechanical-engineering part of this standard German handbook series has been split into 2 volumes owing to postwar developments. This second volume provides comprehensive and thorough coverage of machine construction, refrigeration, mechanical conveying and handling, machine dynamics, precision mechanics, etc. There are as usual references at the end of each chapter and an index in the appendix.

Hypersonic Flow

Edited by A. R. Collar and J. Tinkler. 1960, Academic Press, Inc., New York, N. Y. 432 p., 7½ × 10¼ in., bound. $13.50. Fifteen papers constituting the proceedings of the 11th symposium of the Colston Research Society (Bristol, England, 1959). They cover surveys and details of experimental facilities, techniques for simulating hypersonic flight conditions in the laboratory, investigation of the properties of gases at elevated temperatures, theoretical solutions of particular flow problems, and studies of the configuration, propulsion, and kinetic heating of vehicles designed for hypersonic flight.

International Symposium on Stress Wave Propagation in Materials

Edited by Norman Davids. 1960, Interscience Publishers, Inc., New York, N. Y. 337 p., 6¼ × 9¼ in., bound. $10. In this volume are papers on current world-wide progress in the various areas of earth-layer propagation, viscoelastic materials, metallurgical effects, scabbing, rock breakage, and armor penetration. Research and analysis on various aspects of stress waves, anelastic materials, surface waves, seismic pulses, and photoelasticity also are presented.

The Management of Production

By William Voris. 1960, The Ronald Press Company, New York, N. Y. 450 p., 6¼ × 9¼ in., bound. $6.50. This book describes and analyzes factory operations, from initial research and product design to the completed product, and explains the basic features involved in their organization and management. The author's purpose is to develop a system for understanding and thinking about production management. A survey of the present status of management in the United States leads off the discussion.

Manuel de Pose des Pipe-Lines

By Louis Léveque. 1960, Editions Eyrolles, Paris, France. 181 p., 6¼ × 9½ in., paper. NF. 24.35. A guide for engineers and technicians, this book also demonstrates one aspect of modern developments in construction processes and illustrates the application of assembly-line techniques to this field. An introductory chapter assesses the importance of pipelines in the petroleum industry, describes the features of pipeline projects unique among hydraulic projects, and gives a general survey of the elements of pipeline construction. Succeeding chapters treat in turn each step in construction, such as location, survey, excavation, and final covering of the trench; transport, laying, bending, and joining of the pipe; and miscellaneous topics such as special features of the construction camp, cathodic protection, intersection of pipelines, and the crossing of existing lines and of bodies of water.

Mechanism

By Virgil M. Faires. Fifth Edition. 1960, McGraw-Hill Book Company, Inc., New York, N. Y. 332 p., 6¼ × 9¼ in., bound. $7.50. This revision is a significant departure from the 4th Edition and is taken largely from the author's "Kinematics." Completely rewritten, it now includes treatment of cycloidal motion, roller-gear drives, equivalent mechanisms for acceleration analysis, and planetary trains by relative velocity, by formula, and by tables. It also gives more complete treatment of cam design, helical gear design, hear-tooth action analysis, and of relative velocities and accelerations.

Organizing the Technical Conference

By Herbert S. Kindler. 1960, Reinhold Publishing Corp., New York, N. Y. 139 p., 6¼ × 9¼ in., bound. A guide for those wishing to plan or participate in a technical conference, the discussion focusing on the organization of smaller gatherings. All conference techniques described have been successfully tried, though some are more experimental than others. Attention is given to the purpose and types of conferences, initial planning, program development, auxiliary, supporting and servicing activities, promotion and public relations, documentation, and evaluation and follow-up activities.

Production Tooling Equipment

By S. A. J. Parsons. Second Edition. 1960, Cleaver-Hume Press Ltd., London, England. 328 p., 5¾ × 8¾ in., bound. 28s. Based on lectures delivered to advanced students at the College of Technology, Birmingham, England, this book aims to set out general principles of tooling equipment. This second edition includes new material on ceramic tools, workshop and inspection gages, automation, and other revisions, and includes useful data tables. The appendixes contain typical syllabi and examination questions for the British mechanical certificates and professional degrees in this field.

Professional Engineer's Examination Questions and Answers

By William S. La Londe, Jr. 1960, McGraw-Hill Book Company, Inc., New York, N. Y. 589 p., 5½ × 8¼ in., bound. $7.50. This is the second edition of a useful book which reviews engineering fundamentals in preparation for professional examinations, using mainly past examinations given by various State Boards of Examiners as sources for problems.

Progress in Automation, Vol. 1

Edited by Andrew D. Booth. 1960, Academic Press, Inc., New York, N. Y. 226 p., 5¾ × 8¾ in., bound. $8.50. This first volume of a proposed series contains 11 papers from leading British experts in the field of mechanical automation, recording progress in the United Kingdom in devices for industrial control. Following an introduction to the field, with a brief historical note and definition of terms, are six papers covering analogue conversion techniques, process control systems, position control of machine tools, the inductosyn, nucleonic gages, and nucleonic fluid-density measurement. Five papers on applications deal with the Ferranti and E.M.I. systems of machine-tool control, control in the manufacture of steel strip, and automatic inspection.

Russian-English Metals & Machines Dictionary

By Eugene A. Carpovich. 1960, Technical Dictionaries Co., New York, N. Y. 112 p., 5½ × 8 in., paper. $9. This dictionary comprises about 9000 entries, covering primarily metallurgy and metallurgical engineering, molecular structure and physical properties of metals and alloys, cold and hot metalworking, machines, and machining. It includes also terms related to tools, manufacturing processes, ore beneficiation, and hydrometallurgy as well as abbreviations, Russian shop slang, and Russian transliteration of Western names.

Structural Mechanics

Edited by J. N. Goodier and N. J. Hoff. 1960, Pergamon Press, Inc., New York, N. Y. 594 p., 6¼ × 10 in., bound. $8. This book gives critical reviews and analyses of problems of particular interest to the Navy and the Office of Naval Research in the area of naval structural mechanics. An outline of these problems and the uses of new materials form the introduction; following are papers on elasticity and plasticity in different media, shell theory, wave mechanics, fluid mechanics, instrumentation, and fracture mechanics.

Systems Preliminary Design (Principles of Guided Missile Design)

By Joseph Jerger. 1960, D. Van Nostrand Company, Inc., Princeton, N. J., 625 p., 6¼ × 9¼ in., bound. $14.75. Examines the problems in design and co-ordination of effort faced by the systems engineer in the design of guided missile systems. Introductory chapters cover general design considerations, missile-system reliability, and guidance and control-design data. The following six chapters discuss in detail missile design data for the various aspects of missile construction and performance. The final chapter presents, discusses, and illustrates a preliminary design procedure proved valuable in the author's experience.

The Theory of Heat Radiation

By Max Planck. 1959, Dover Publications, Inc., New York, N. Y. 224 p., 5½ × 8 in., paper. $1.50. A reprint of the 1914 translation of the second edition (1931) of Planck's "Waernaestrahlung," in which he sets forth his hypothesis of quanta, as part of his special theory of radiation. This theory is presented as a possible way of accounting for the processes of radiant energy from the same point of view as for the processes of molecular motion. The treatment starts from the simple known experimental laws of optics, and advances, by gradual extension and by addition of the results of electrodynamics and thermodynamics, to the problems of the spectral distribution of energy and of irreversibility.

ASTM Manual for Rating Motor Fuels by Motor and Research Methods. Fourth Edition.

Published 1960 by the American Society for Testing Materials, Philadelphia, Pa. 196 p., 6¼ × 9¼ in., bound. $7.50. This revision brings up to date both the motor and research methods of testing for knock characteristics below 100 octane number and presents a new research method for above 100. Six appendixes give technical data on the installation, operation, and maintenance of knock-testing equipment.

Advances in Computers, Vol. 1

Edited by Franz L. Alt. 1960, Academic Press, Inc., New York, N. Y. 316 p., 6¼ × 9¼ in., bound. $10. This volume is the first in a series intended to survey progress in computer programming at frequent intervals and to present the information to others than specialists in the field. The six papers contained here are on methods of programming for business, scientific, and lingual applications. Automatic translation of languages, machine

recognition of spoken words, programming for gases, numerical weather predictions, general business applications, and binary arithmethic useful in designing computing equipment, are the specific topics covered.

Advances in Space Science, Vol. 2

Edited by Frederick I. Ordway, III. 1960, Academic Press, Inc., New York, N. Y. 450 p., $6^1/_4 \times 9^1/_4$ in., bound. $13. Seven American scientists contribute detailed chapters covering six major areas of space science—space physics: "The marriage of geophysics and astrophysics to rocket technology"; the basic scientific and technological purposes and the current methods of tracking of space exploration vehicles; the behavior of materials in the space environment; plasma propulsion devices; electrostatic propulsion devices; and attitude control of space vehicles.

Automatic Language Translation

By Anthony G. Oettinger. 1960, Harvard University Press, Cambridge, Mass. 380 p., $6^1/_4 \times 9^1/_4$ in., bound. $8.50. Presenting the results of ten years of study of the problems of automatic translation, this book emphasizes fundamental lexical and technical aspects, reflecting the author's conviction that an operating automatic dictionary is a basic requirement for the eventual development of an automatic translator. The investigations were confined to translation from Russian to English, and this book describes in detail a proved system of automatic dictionary compilation and operation in that area, but one adaptable to other pairs of languages. The final chapter discusses affixed interpretation—the extension of an automatic dictionary toward an automatic translator.

Avionics Research: Satellites and Problems of Long Range Detection and Tracking (AGARDograph No. 40)

Edited by E.V.D. Glazier and others. 1960, Pergamon Press, New York, N. Y. 257 p., $6^1/_4 \times 10$ in., bound. 63s. The proceeding of the 1958 AGARD Symposium on the Detection and Tracking of Targets at High Altitudes and Extreme Ranges. The first six papers are theoretical discussions of radar, particularly ionospheric radar and its use in long-range tracking. Other papers record practical experiences with radar, such as echoes received from earth satellites Alpha and Beta, and satellite observations made with the Millstone Hill Radar. Papers dealing with aspects of radio astronomy include those discussing observations of and propagation from the Russian earth satellites, radio-signal-strength records from the Explorer satellites, tracking from the California co-ordinated doppler receiving stations, and the 40 Mc "Image" signals from the Alpha satellite.

Basic Graphical Kinematics

By Harold B. Kepler. 1960, McGraw-Hill Book Company, Inc., New York, N. Y. 314 p., $5^3/_4 \times 8^1/_2$ in., bound. $6. The traditional topics of kinematics are covered with emphasis on the graphical approach: displacements, velocities, accelerations; cams, gears, chains, and belts. Basic techniques for analysis are presented with vectors and vector equations, then the equivalent linkage concept, Coriolis' law, motion curves, acceleration, and gear problems are discussed. Kinematic drawing and displacements, skeleton drawing, and drafting techniques are a special feature of the book.

Digital Computer and Control Engineering

By Robert Steven Ledley. 1960, McGraw-Hill Book Company, Inc., New York, N. Y. 835 p., $6^1/_4 \times 9^1/_4$ in., bound. $14.50. This comprehensive elementary engineering textbook presents the major aspects of digital computers and controls for the standard engineer. The first part covers general concepts of programming applicable to any computer, and concludes with an exposition of the International Algebraic Language ALGOL. Digital systems design based on numerical analysis and data processing, and logical design of digital circuits utilizing "designation numbers" and applied to all types of arithmetic compounds, are developed and explained. The final part deals with the electronic design of digital circuits, utilizing solid-state and magnetic core components.

Elementary Theoretical Fluid Mechanics

By Karl Brenkert, Jr. 1960, John Wiley & Sons, Inc., New York, N. Y. 348 p., $6^1/_4 \times 9^1/_4$ in., bound. $7.50. Here the fundamentals of fluid mechanics are developed with a minimum of attention to practical applications in order to provide a basis for the study of applications in many fields of advanced specialization. The author adheres to the basic equations almost exclusively to promote versatility in the fundamentals and avoid formula dependence. The text covers fluid statistics, conservation of matter and of energy, momentum, friction, dimensional analysis, and potential flow. Brief treatments of acoustic velocity, cavitation, thermodynamics, and boundary-layer theory are presented in appendixes.

Elliptic Functions With Complex Arguments

By F. M. Henderson. 1960, The University of Michigan Press, Ann Arbor, Mich. Various pagings, $8^3/_4 \times 11^1/_4$ in., bound. $8. An introductory chapter summarizes enough of the theory of elliptic integrals and functions to make the tables and charts understandable. These tables and charts form three quarters of the volume, and are intended to fill the need for complex values of the elliptic functions that arises in connection with plane harmonic, or "potential" problems, such as the mapping problems of hydrodynamics, heat conduction, and electromagnetic theory. The charts are drawn up so as to display the solution of the typical mapping problems, and to show in compact and convenient form the (complex) values of the elliptic functions for the whole range of (complex) values of the argument. Opposite each chart is a table giving values to four significant figures. The functions dealt with are $s = sn\ w$, $z = cn\ w$, $z = dn\ w$, and $E = E(w)$.

Engineering Design With Rubber

By A. R. Payne and J. R. Scott. 1960, Interscience Publishers, Inc., New York, N. Y. 255 p., $5^3/_4 \times 8^3/_4$ in., bound. $8. Papers presented at a 1958 symposium on dynamic design with rubber, sponsored by the Research Association of British Rubber Manufacturers, and some additional material on the basic physical and dynamic properties of rubber, form this volume. It is a practical guide to the properties, testing, and design of rubber as an engineering material. Appendixes contain British and U. S. standards for testing methods, and for natural and synthetic rubber compounds, and the properties of vulcanized natural and synthetic rubbers.

LIBRARY SERVICES

Engineering Societies Library books, except bibliographies, handbooks, and other reference publications, may be borrowed by mail by ASME members for a small handling charge. The Library also prepares bibliographies, maintains search and translation services, and can supply a photoprint or a microfilm copy of any item in its collection. Address inquiries to R. H. Phelps, Director, Engineering Societies Library, 29 West 39th Street, New York 18, N. Y.

ASME BOILER AND PRESSURE VESSEL CODE

Interpretations

The Boiler and Pressure Vessel Committee meets regularly to consider "Cases" where users have found difficulty in interpreting the Code. These pass through the following procedure: (1) Inquiries are submitted by letter to the Secretary of the Boiler and Pressure Vessel Committee, ASME, 29 West 39th St., New York 18, N. Y.; (2) Copies are distributed to Committee members for study; (3) At the next Committee meeting interpretations are formulated to be submitted to the ASME Board on Codes and Standards, authorized by the Council of the Society to pass upon them; (4) They are submitted to the Board for action; (5) Those which are approved are sent to the inquirers and are published in MECHANICAL ENGINEERING.

(The following Case Interpretations were formulated at the Committee meeting Sept. 27, 1960, and approved by the board on Nov. 1, 1960.)

Annulment of Cases
Case 1268

Essence of Case included in Section VIII (June 10, 1960 Addenda)

Case 1177-4 (*Special Ruling*)
Expansion Joints

Revise the fifth sentence of the Reply to read:

The joint shall be shop inspected during fabrication by a qualified inspector who shall sign the partial data report;

this inspection is limited to include materials, fabrication and such details as are covered by the Code rules except that minimum thickness limitations do not apply to the expansion element and that the inspection of the expansion element covers material and workmanship only.

Case 1196-2 (*Special Ruling*)
Aluminum Bronze Alloy Centrifugal Castings

Inquiry: May aluminum bronze castings conforming to Alloy 9A in ASTM Specification B 148–52 or B 271-54 be used in the construction of welded pressure vessels under the requirements of Section VIII of the Code? What allowable design stresses may be used?

Reply: It is the opinion of the Committee that the material specified in the Inquiry may be used in the construction of welded unfired pressure vessels under the rules of Section VIII provided the following additional requirements are complied with:

(1) The maximum allowable stress values shall be those given in Table 1.

Table 1 Maximum Allowable Stress Values

Metal Temp. Not Exceeding Deg. F	Allowable Stress Value Psi Alloy 9A
100	15,700
150	15,500
200	15,000
250	14,300
300	14,000
350	13,700
400	13,600
450	13,500
500	13,000
550	11,400
600	7,400

Note: The allowable design stresses are subject to a casting factor as per Pars. UNF-8 and UG-24.

(2) The qualification of the welding procedure and the welders shall conform to the requirements of Section IX. A separate welding procedure and performance qualification shall be made for this material.

(3) The requirements in Par. UNF-65 shall apply to low temperature operation.

Case 1204-6 (*Special Ruling*)
Quenched and Tempered Steel

Revise the last sentence of Item 6 of the Reply to read:

The stress relieving temperature shall be between 1000 and 1100 F using the holding periods specified in Footnote 1 to Par. UCS-56.

Case 1244-1 (*Special Ruling*)
Nickel-Iron-Chromium-Moly-Copper Alloy

Inquiry: May nickel-iron-chromium-moly-copper alloy seamless condenser and heat exchanger tubes, rod and bars, seamless pipe and tubes, plate, sheet, and strip with the following chemical analysis and minimum mechanical properties, but otherwise conforming, respectively, to Specifications SB-163, SB-166, SB-167 and SB-168, be used in Code construction under Section VIII?

Chemical Requirements

Nickel, per cent	38.–46.
Carbon, max. per cent	0.05
Manganese, max. per cent	1.00
Iron	Bal
Sulphur, max. per cent	0.03
Silicon, max. per cent	0.05
Copper, max. per cent	1.5–3.0
Chromium, per cent	19.5–23.5
Aluminum, max. per cent	0.20
Titanium, per cent	0.6–1.2
Molybdenum, per cent	2.5–3.5

Tensile Requirements

Tensile strength, psi	85,000
Yield point, psi, .2 per cent offset	35,000
Elongation in 2", per cent	30

If so, what design stresses shall be employed at temperatures up to 700 F?

Reply: It is the opinion of the Committee that nickel-iron-chromium-molybdenum-copper alloy forms as shown in Table I may be used in Code construction provided:

(1) They meet the chemical analysis and minimum mechanical properties described in the Inquiry and otherwise conform to ASME specifications for the respective forms.

Table I

Form	Specification
Seamless Condenser and Heat Exchanger Tubes	SB-163
Rods and Bars	SB-166
Seamless Pipe and Tube	SB-167
Plate, Sheet and Strip	SB-168

(2) The qualification of the welding procedure and the welders shall conform to the requirements of Section IX Part B. A separate welding procedure and performance qualification shall be made for this material.

(3) The maximum allowable design stress shall not exceed the following:

For Metal Temperatures Not Exceeding	Design Stress, Psi
100 F	21,000
200 F	20,250
300 F	18,700
400 F	17,550
500 F	16,650
600 F	16,200
700 F	15,650

Note: Heat treatment after forming or fabrication is neither required nor prohibited.

Case 1274N-3 (*Special Ruling*)
Special Material Requirements

Par. (2)(a)1 of the Reply:

Delete the words "required by the specification."

Add the following as a new Par. (3) to the Reply:

(3) When steel castings conforming to Specifications SA-216, SA-217, SA-351 and SA-352 are used in the construction of nuclear vessels, they shall meet the requirements in (a), (c), (d), (e), and (f) of Item (2) as given above except that the penetrant oil method of testing shall be used in place of magnetic particle inspection for non-magnetic material. The maximum casting quality factor permitted is 100 per cent except that under Section I for Power Boilers the maximum allowable S value in Table P-7 shall not exceed 0.95 times S.

Case 1282 (*Special Ruling*)
External Pressure Chart for Aluminum Alloy 5083

Inquiry: Is it permissible to construct vessels subject to external pressure from aluminum alloy GM41A-O and GM41A-H113 plate made according to Specification SB-209, except that the yield strength will not be less than 18,000 psi? If so, what rules and design chart may be used?

Reply: It is the opinion of the Committee that aluminum plate, as covered in the Inquiry, may be used for the construction of vessels subject to external pressure provided that the rules in Section VIII are complied with.

The required thickness of shells and heads, and the required moment of inertia for stiffening rings, shall be determined from the chart in Fig. UNF-28.23. (A copy of the chart will be included in the publication of the Case).

Proposed Case 1283 (*Special Ruling*)
Rules for Construction of Gas Fired Jacketed Steam Kettles

Inquiry: Neither Section I nor Section VIII of the ASME Boiler and Pressure Vessel Code as now written precisely covers gas-fired jacketed steam kettles. Under what rules shall such vessels be constructed?

Reply: Pending development of rules for fired pressure vessels other than steam boilers, it is the opinion of the Committee that gas-fired jacketed steam kettles may be constructed under the rules of Section VIII provided the following additional requirements are met:

1 Welded joints in contact with products of combustion shall be of Type No. 1 of Table UW-12.

2 When parts subjected to pressure are made of carbon steel material, the minimum thickness shall be $\frac{1}{4}$ inch. The minimum thickness of stainless steel or nonferrous pressure parts shall be as specified in the applicable part of Subsection C.

3 When in contact with products of combustion, carbon steel material shall be firebox quality and austenitic stainless steel parts shall be of either the extra-low

carbon or stabilized grades.

4 Structural grade carbon steel shall not be used for any pressure part.

5 The operating pressure of the jacket shall not exceed 50 psi.

6 Vessels constructed under this Case shall be inspected by a qualified inspector and shall not be marked with the UM symbol regardless of volume.

7 No steam or water shall be withdrawn from the jacket for use externally to the vessel.

8 The capacity of the safety valve in pounds of steam per hour shall be at least equal to the Btu rating of the burner divided by 1000.

9 The jacket shall be furnished with the following minimum appurtenances and controls:

(a) A pressure gage.

(b) A water gage glass.

(c) A separate connection, fitted with a check valve and stop valve, for adding water to the jacket (the water may be added while the vessel is not under pressure).

(d) An automatic gas valve controlled by pressure or temperature to maintain the steam pressure in the jacket below the safety valve setting.

(e) A low water cut-off that will cut off the fuel to the burner if the water in the jacket drops below the lowest permissible water level as established by the manufacturer.

(f) A safety pilot control that will cut off the fuel to both the main burner and the pilot burner in case of pilot flame failure.

Case 1285 (*Special Ruling*)
Manganese Limit of SA-105 Grade II Forgings

Inquiry: May the manganese limit of SA-105 Grade II forgings be increased to 1.35 per cent when impact requirements are imposed?

Reply: It is the opinion of the Committee that it will meet the intent of the Code if the manganese limit of SA-105 Grade II forgings is increased to 1.35 per cent when impact testing in accordance with SA-350 or Par. UG-84 is specified. The carbon content shall be reduced to 0.30 per cent maximum.

Stress allowances shall be the same as for Specification SA-105 Grade II forgings.

Materal conforming in other respects to SA-105 Grade II except with manganese 1.35 per cent maximum and carbon of .30 per cent maximum shall be classified as P-1 in Table Q-11.1 of Section IX.

Case 1287 (*Special Ruling*)
Revised Mechanical Property Requirements for Nickel-Chromium-Iron Alloy Specifications SB-163, SB-166, SB-167 and SB-168

Inquiry: Since new data indicates that the allowable design stress values now published in Table UNF-23 are slightly excessive when the material is supplied in the annealed condition (temper) to the present Specifications SB-163, SB-166, SB-167, and SB-168, may these same allowable design stress values be used in Code construction if the annealed material is supplied to higher specified yield strengths?

Reply: It is the opinion of the Committee that annealed Nickel-Chromium-Iron Alloy for the specifications in the inquiry may be used in Code construction employing the design stresses in Table UNF-23, provided that the minimum yield strength of the material is as noted in Table 1 and provided that the annealed material meets all other requirements of the specifications and modified mechanical requirements of the specifications as noted in Table 2. The footnotes of the tables in the published specifications apply to Tables 1 and 2.

Table 1

		Min. Yield Strength (0.2% offset)
Nickel-Chromium-Iron		
Bars, Rods, Shapes and Forgings		
SB-166	Hot or Cold Worked—Annealed	35,000
Bolting		
SB-166	Hot or Cold Worked—Annealed—All Sizes	35,000
Pipe or Tube		
SB-167	Seamless-Annealed—5" O.D. and Under	35,000
SB-167	Seamless-Annealed—Over 5" O.D.	30,000
Condenser Tube		
SB-163	Seamless-Annealed—All Sizes to 3", Incl.	35,000
Plate, Sheet or Strip		
SB-168	Hot or Cold Rolled—Annealed	35,000

Table 2

	Ten. Str. min. psi	Yield Str. (0.2% offset) min. psi	Elongation in 2 in. min. percent	Rockwell Hardness or equivalent
SB-163				
Table II Nickel-Chromium-Iron Alloy Annealed	80,000	35,000	30	B92 max.
SB-166				
Table I Annealed—All Bars and Rods	80,000*	35,000	30	—
SB-167				
Table I Annealed				
5 in. in outside diam and under	80,000	35,000	30	—
over 5 in. in outside diam	80,000	30,000	35	—
SB-168				
Table I				
Hot Rolled Plate, Annealed	80,000	35,000	30	130–180
Hot Rolled Sheet, Annealed	80,000	35,000	30	92B max.
Cold Rolled Sheet, Annealed	80,000	35,000	30	92B max.
Cold Rolled Strip, Annealed	80,000	35,000	30	88B max.

* 110,000 psi max.

Proposed Case 1288 (*Special Ruling*)
Aluminum Bronze Castings Conforming to B148-52

Inquiry: May aluminum bronze castings conforming to Alloy 9C of ASTM Specification B148-52 be used in the construction of pressure vessels under Section VIII of the Code? If so, what design stresses may be used?

Reply: It is the opinion of the Committee that Alloy 9C may be used in the construction of unfired pressure vessels under the rules of Section VIII provided the following requirements are complied with:

(1) The composition is restricted as follows:

Copper, min. per cent	83.0
Aluminum, per cent	10.0–10.4
Iron, per cent	3.0–5.0
Manganese, max. per cent	0.5
Nickel, max. per cent	1.0
Total named elements, per cent	99.5

(2) The maximum allowable stress values shall be as follows:

Maximum Allowable Stress Values

Metal Temperature Not Exceeding F	Allowable Stress Value, Psi
100	18,500
150	17,900
200	17,500
250	17,000
300	16,700
350	16,300
400	15,800
450	15,300
500	12,000
550	9,700
600	8,500

Note: The allowable design stresses are subject to a casting factor as per Pars. UNF-8 and UG-24.

(3) The qualification of the welding procedure and the welders shall conform to the requirements of Section IX except that the radius of the mandrel used in the guided bend tests shall be as follows:

Thickness of Specimen	Radius of Mandrel (B)*	Radius of Die (D)*
3/4 in.	1 1/4 in.	1 11/16 in.
t	3 1/3 t	4 1/3 t + 1/16 in.

* Corresponds to dimensions B and D in Figs. Q-8 and QN-8, Section IX; other dimensions to be in proportion.

A separate welding procedure and performance qualification shall be made for this material.

(4) The provisions in Par. UNF-65 shall apply.

(5) If welded, the material shall be heat-treated after all welding at 1150–1200 F for 1 1/2 hr at temperature for the first inch of cross section thickness plus 1/2 hr for each additional inch of section thickness. Material shall then be air cooled.

Proposed Case 1289 (*Special Ruling*) Aluminum Bronze Forgings Complying with Specification SB-150

Inquiry: May aluminum bronze forgings with the following chemical composition, with tensile properties for shapes and otherwise complying with Specification SB-150 Alloy No. 1 be used in Code Construction under Section VIII? What design stresses are applicable?

Chemical Composition	
Copper, per cent	85.0–89.0
Aluminum, per cent	8.5–10.0
Iron, max. per cent	4.0
Nickel, max. per cent	1.0
Silicon, max. per cent	0.25
Manganese, max. per cent	1.5
Tin, max. per cent	0.6
Zinc, max. per cent	1.0
Sum of Named Elements, per cent	98.9

Reply: It is the opinion of the Committee that aluminum bronze forgings with the foregoing specified chemical composition with tensile requirements for shapes and otherwise complying with SB-150 Alloy No. 1 may be used in Code construction under Section VIII with the following additional requirements:

(1) Tensile test specimens shall be machined from coupons forged from the stock, from prolongations of the forgings, or from forgings taken from the lot.

(2) The qualification of the welding procedure and the welders shall conform to the requirements of Section IX. A separate welding procedure and performance qualification shall be made for this material.

(3) The provisions of Par. UNF-65 shall apply.

(4) The maximum allowable stress values shall be as follows:

Temperature, Deg F	Stress, Psi
up to 100	17,200
150	16,800
200	16,500
250	16,000
300	15,600
350	15,200
400	14,800
450	14,500
500	12,400
550	10,600
600	10,000

Proposed Revisions and Addenda to Boiler and Pressure Vessel Code . . .

As NEED arises, the Boiler and Pressure Vessel Committee entertains suggestions for revising its Code. Revisions approved by the Committee are published here as proposed addenda to the Code to invite criticism. If and as finally approved by the ASME Board on Codes and Standards, and formally adopted by the Council, they are printed in the semiannual addenda supplements to the Code. Triennially the addenda are incorporated into a new edition of the Code.

In the following the paragraph numbers indicate where the proposed revisions would apply in the various sections of the Code.

Power Boilers, 1959

PAR. P-2(c) Delete this Paragraph.

TABLE P-7 Add the stress values for SA-182 and SA-268 Grade TP446

PAR. P-23(a)(2) Revise to read:

For steam piping connected to the superheater outlet header up to the first stop valve in each connection, the value of P, except as otherwise provided for in (4), shall be not less than the lowest pressure at which any valve on the superheater is set to blow, or not less than 85 per cent of the lowest pressure at which any drum safety valve is set to blow, whichever is greater, and the S value for the material used shall not exceed that permitted for the expected steam temperature.

PAR. P-26 Revise to read

Maximum allowable working pressure in pounds per square inch for seamless nonferrous tubes and pipes conforming to specifications given in Section II of the Code are to be determined by the following formula, for outside diameters 1/2 in. to 6 in., inclusive, and for wall thicknesses not less than No. 18 BWG (0.049 in.).

$$P = \frac{2S(t - C)}{D} \quad \text{and} \quad t = \frac{PD}{2S} + C$$

P = maximum allowable working pressure, pounds per square inch

t = minimum wall thickness, inches

S = maximum allowable working stress from Table P-6, pounds per square inch

D = outside diameter of tube or pipe, inches

C = allowance for threading and minimum structural stability, inches

The values of C do not include any allowance for corrosion and/or erosion, and additional thickness should be provided where they are expected. The allowances for threading and minimum structural stability are not intended to provide for conditions of misapplied external loads or for mechanical abuse.

The values of C shall not be less than the following:

Use	Size Range	Value of C
Boiler Tubes—Rolled (1)	1/4–6 in. OD, incl.	0
Boiler Tubes or Pipe—Threaded	Under 4 in. OD	Depth of thread, but not less than 0.065 (2)
Pipe—Threaded	4–6 in. OD incl.	Depth of thread (2)
Pipe—Plain End	Under 4 in. OD	0.065
Pipe—Plain End	4–6 in. OD incl.	0

1 Additional wall thickness should be provided where wear due to cleaning operations is expected, and to compensate for thinning in setting the tubes in tube plates.

2 Depth of thread shall be taken as

$$\frac{0.8}{\text{Number of threads per inch}}$$

PAR. P-296 Revise to read:

Each boiler shall have a steam gage connected to the steam space or to the water column or its steam connection. The gage or connection shall contain a syphon or equivalent device which will develop and maintain a water seal that will prevent steam from entering the gage tube. A valve or cock shall be placed in the gage connection adjacent to the gage. An additional valve or cock may be located near the boiler providing it is locked or sealed in the open position. No other shut-off valves shall be located between the gage and the boiler. The pipe connection shall be of ample size and arranged so that it may be cleared by blowing out. Steam gage connections which are filled with water or steam shall be suitable for the maximum allowable working pressure and steam temperature, but if the temperature exceeds 406 F, brass or copper pipe or tubing shall not be used. The connections to the boiler, except the syphon if used, shall not be less than 1/4 in. standard pipe size but where steel or wrought-iron pipe or tubing is used, they shall not be less than 1/2 in. inside diameter. The minimum size of a syphon, if used, shall be 1/4 in. inside diameter.

Material Specifications, 1959

The Boiler and Pressure Vessel Committee approved adding to Section II the following new specifications:

SA-371-53T Corrosion Resisting Chrom-

ium and Chromium Nickel Steel Welding Rods and Bare Electrodes.

SA-435-59T Ultrasonic Testing and Inspection of Steel Plates of Firebox and Higher Quality

The Boiler and Pressure Vessel Committee approved adding to Section II the following revisions to specifications:

Aluminum and Aluminum Alloys

SB-209-60T	Aluminum-Alloy Sheet and Plate (except revisions have been made to Tables II, IV, V, and new Tables XI and XII have been added).
SB-221-59T	Aluminum-Alloy Extruded Bars, Rods and Shapes (except a new Table XII has been added).

Copper and Copper Alloys

SB-42-60	Seamless Copper Pipe, Standard Sizes
SB-43-60	Seamless Red Brass Pipe, Standard Sizes
SB-75-60	Seamless Copper Tube
SB-111-60	Copper and Copper-Alloy Seamless Condenser Tubes and Ferrule Stock
SB-152-60	Copper Sheet, Strip, Plate and Rolled Bar
SB-249-60	General Requirements for Wrought Copper and Copper-Alloy Rod, Bar and Shapes
SB-315-60	Copper-Silicon Alloy Seamless Pipe and Tube

Low-Pressure Heating Boilers, 1959

PAR. H-24(b) Revise the last sentence to read:

A fully supported line is a bent or welded corner joint, or is a line tangent to a row of tubes or stays not over $1p$ apart between edges and extending to within $1p$ of the shell.

PARS. H-55 and H-108 Revise to read:

Each steam boiler shall have a steam gage connected to its steam space or to its water column or to its steam connection. The gage or connection shall contain a syphon or equivalent device which will develop and maintain a water seal that will prevent steam from entering the gage tube. The connection shall be so arranged that the gage cannot be shut off from the boiler except by a cock placed in the pipe at the gage and provided with a tee or lever handle arranged to be parallel to the pipe in which it is located when the cock is open. The connections to the boiler (except the syphon, if used) shall be not less than $\frac{1}{4}$ in. standard pipe size, but when steel or wrought iron pipe or tubing is used, they shall be not less than $\frac{1}{2}$ in. inside diameter. The minimum size of a syphon, if used, shall be $\frac{1}{4}$ in. inside diameter.

Also: Delete the third paragraph of Pars. H-55 and H-108.

Miniature Boilers, 1959

PAR. M-15 Revise to read:

Each miniature boiler shall be equipped with a steam gage having its dial graduated to not less than $1\frac{1}{2}$ times the maximum allowable working pressure. The gage shall be connected to the steam space or to a steam connection to the water column. The gage or connection shall contain a syphon or equivalent device which will develop and maintain a water seal that will prevent steam from entering the gage tube. The minimum size of a syphon, if used, shall be $\frac{1}{4}$ in. inside diameter.

Unfired Pressure Vessels, 1959

PAR. U-1(e)(2) Second paragraph, delete second sentence. Add "See Par. UW-2(c))."

PAR. UG-6(b) Delete this paragraph.

PAR. UG-23(d) Delete this paragraph.

PAR. UG-34 Under "C" value for Fig. UG-34(f) and Fig. UG-34(i): Delete "but omitting radiographic examination"

PAR. UG-116(e)(1) Delete and replace with:

(1) The letters XR shall be applied under the Code symbol to those vessels of welded construction with joints which have been completely radiographed to the extent required by the Code.

PAR. UW-2 Delete and replace with:

UW-2 **Service Restrictions** (a) Vessels that are to contain lethal[1] substances, either liquid or gaseous, shall have all joints of Category A (see Par. UW-3) in accordance with Type No. (1) of Table UW-12 and all joints of Categories B and C in accordance with Types No. (1) or No. (2) of Table UW-12. All butt-welded joints shall be fully radiographed. When fabricated of carbon or low-alloy steel, such vessels shall be stress-relieved.

(b) Vessels that are to operate below −20 F shall have all joints of Category A (see Par. UW-3) in accordance with Type No. (1) of Table UW-12 and all joints of Categories B and C in accordance with Types No. (1) or No. (2) of Table UW-12 when impact tests in accordance with Par. UG-84 are required for the material or weld metal.

(c) Unfired steam boilers with design pressures exceeding 50 psi shall have all joints of Category A (see Par. UW-3) in accordance with Type No. (1) of Table UW-12 and all joints in Category B in accordance with Types No. (1) or No. (2) of Table UW-12. All butt-welded joints shall be fully radiographed. When fabricated of carbon or low-alloy steel such vessels shall be stress relieved. (See also Pars. U-1(e)(2), UCS-16(b) and UCS-25).

PAR. UW-3 Add new Par. UW-3

UW-3 Welded Joint Category (a) The term "Category" as used herein defines the location of a joint in a vessel, but not the type of joint. The "Categories" established by this paragraph are for use elsewhere in the Code in specifying special requirements regarding joint type and degree of inspection for certain welded pressure-joints. Since these special requirements, which are based on service, material, and thickness, do not apply to every welded joint, only those joints to which special requirements apply are included in the Categories. The special requirements will apply to joints of a given Category only when specifically so stated. The joints included in each Category are designated as joints of Category A, B, C, and D below. Fig. UW-3 illustrates typical joint locations included in each Category.

(1) Category A. Longitudinal welded joints within the main shell, communicating chambers,[2] transitions in diameter, or nozzles; any welded joint within a formed or flat head.

(2) Category B. Circumferential welded joints within the main shell, communicating chambers,[2] nozzles, or transitions in diameter including joints between the transition and a cylinder at either the large or small end; circumferential welded joints connecting formed heads to main shells, to transitions in diameter, to nozzles, or to communicating chambers.[2]

(3) Category C. Welded joints connecting flanges, Van Stone laps, tube sheets, or flat heads to main shell, to formed heads, to transitions in diameter, to nozzles or to communicating chambers.[2]

(4) Category D. Welded joints connecting communicating chambers[2] or nozzles to main shells, to transitions in diameter, or to heads, and those joints connecting nozzles to communicating chambers.[2] (For nozzles at the small end of a transition in diameter, see Category B.)

(b) When butt-welded joints are required elsewhere in the Code for Category B, an angle joint connecting a transition

[2] Communicating chambers are defined as appurtenances to the vessel which intersect the shell or heads of a vessel and form an integral part of the pressure containing enclosure, e.g., sumps.

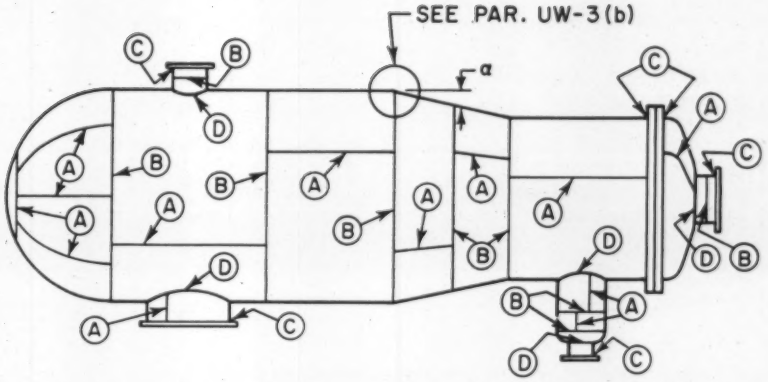

Fig. UW-3 Illustration of welded joint locations typical of categories A, B, C, and D

in diameter to a cylinder shall be considered as meeting this requirement provided the angle α (See Figure UW-3) does not exceed 30 degrees. All requirements pertaining to the butt-welded joint shall apply to the angle joint.

FIGURE UW-3 Add this new figure

PAR. UW-11(a) First sentence delete Types No. 1 and No. 2 and replace with Types No. (1) and No. (2).

Add a note following introductory sentence as follows:

Note: The requirements specifying which joints must be butt welded will be found in the paragraphs referenced below.

PAR. UW-11(a)(3) Delete (See Par. U-1(e)(2)), and replace with (See Par. UW-2(c)).

PAR. UW-11(a)(4) Delete this Paragraph.

PAR. UW-11(a)(5) Delete sumps and replace with communicating chambers.

PAR. UW-11(a)(6) Delete and replace with:

(6) All butt-welded joints in a vessel or vessel section where the design of the vessel or vessel section is based on the use of the joint efficiency permitted by Par. UW-12(a). All joints of Categories A and B (see Par. UW-3) shall be of Types No. (1) or No. (2). In the case of a vessel section, the circumferential butt welds joining it to adjacent shell sections or heads shall be fully radiographed.

PAR. UW-11(b) Delete and replace with:

(b) *Spot Radiography* Butt-welded joints made in accordance with Types No. (1) or No. (2) of Table UW-12 which are not required to be fully radiographed by (a) shall be examined by spot-radiographing in accordance with Par. UW-52, except as described in (c).

Note: This requirement specifies spot-radiography for butt welds of Types No. (1) or No. (2) that are used in a vessel, but does not preclude the use of fillet and/or corner welds permitted by other paragraphs, such as for nozzle and manhole attachments, welded stays, flat heads, etc., which need not be spot radiographed.

PAR. UW-12 In the second sentence, delete longitudinal and circumferential.

PAR. UW-35(b) Delete Type No. 2 and replace with Type No. (2). Also, delete the words "and adding filler metal from one side only."

PAR. UW-51(c) Revise to read:

(c) Single-welded butt joints made by using a backing strip which is left in place (Type No. (2) of Table UW-12) may be radiographed provided the backing strip does not interfere with the interpretation of the resultant radiographs.

PAR. UW-52(a) In the first sentence, delete longitudinal and circumferential welded and replace with butt-welded.

PAR. UCS-11(a) Revise to read:

Materials for nuts and washers shall conform to Specification SA-194 or to the requirements for nuts in the specification for the bolting material with which they are to be used.

PAR. UCS-19 Add as a new paragraph to read:

PAR. UCS-19 *Welded Joints*. When radiographic examination is required for butt-welded joints by Par. UCS-57, joints of Categories A and B (see Par. UW-3) shall be of Types No. (1) or No. (2) of Table UW-12.

TABLE UCS-23 Revise the first three sentences of the unnumbered notes to read:

The stress values in this table may be interpolated to determine values for intermediate temperature.

Stress values in restricted shear such as dowel bolts, rivets, or similar construction in which the shearing member is so restricted that the section under consideration would fail without reduction of area shall be 0.80 times the values in the above table.

Stress values in bearing shall be 1.60 times the values in the above table.

PAR. UCS-56(a) In the first sentence, delete main.

PAR. UCS-56(b) Delete the first sentence, and replace with:

(b) When the welded joint connects parts that are of different thickness, the thickness to be used in applying the requirements for stress-relieving in (a) shall be the following:

PAR. UCS-67(b) Revise to read:

(b) When required by Par. UW-2(b), all joints of Category A (see Par. UW-3) shall be in accordance with Type No. (1) of Table UW-12 and all joints of Categories B and C shall be in accordance with Types No. (1) or No. (2) of Table UW-12.

TABLE UNF-23 Under Aluminum and Aluminum Alloy Products, Pipe & Tube revise SB-210 Grade GM51A to read: SB-235; SB-241 Grade GM51A. Also add the statement written above for Table UCS-23, as unnumbered notes under the tables for Aluminum & Aluminum Alloy Products, Copper & Copper Alloys & Nickel & High Nickel Alloys.

PAR. UHA-21 Add a new paragraph as follows:

UHA-21 *Welded Joints* When radiographic examination is required for butt-welded joints by Par. UHA-33, joints of Categories A and B (see Par. UW-3) shall be of Type No. (1) or No. (2) of Table UW-12.

PAR. UHA-33(b) At the beginning of the first and second sentences add Butt-welded joints in . . .

PAR. UHA-33(c) At the beginning of the sentence, delete all and replace with Butt-welded joints in . . .

TABLE UHA-23 Add the materials and stress values shown. Also, revise the first three sentences of the unnumbered notes to read as written above for Table UCS-23.

PAR. UA-48(c) Delete

PAR. UA-60(o) Add the following definition before *Arc Welding:*

Angle Joint A joint between two members located in intersecting planes between zero (a butt joint) and 90 degrees (a corner joint)

PAR. UA-60(o) Revise the note after the definition for Double-Welded Butt Joint as follows:

Note: A joint with filler metal added from one side only may be considered equivalent to a double-welded butt joint only within the limitations of Type No. (1) of Table UW-12.

Welding Qualifications, 1959

PAR. Q-11 V-7 Revise to read:

V-7(a) In arc welding, the omission of the backing strip in welding single welded butt joints; and in gas welding, the omission of the backing strip in welding single welded butt joints.

(b) In any welding process, the omission or addition of consumable backing rings or strip.

PAR. Q-11 V-13 Add a new Par. to read: V-13 The omission of inert gas backing.

PAR. Q-22 W-7 Add a new Par. to read: W-7 In any welding process, the omission or addition of consumable backing rings or strip.

PAR. Q-22 W-8 Add a new Par. to read: W-8 The omission of inert gas backing.

TABLE QN-11.2 Revise grouping for Nickel and Nickel-Base Alloys to read:

Nickel and Nickel-Base Alloys

Filler Alloy	Metal Arc	Oxy-Acetylene	Inert-Gas Arc
F-41 Nickel (0.75 max C)	E3N11	RN41	ERN61
F-42 Nickel (0.10 max C)	E4N11		
F-43 Nickel-Copper (67 Ni-30 Cu-0.40 max C)	E3N10	RN40	ERN60
F-44 Nickel-Copper (67 Ni-30 Cu-0.15 max C)	E4N10		
F-45 Nickel-Chromium-Iron (77 Ni-15 Cr-7 Fe)	E3N12	RN42	ERN62
F-46 Nickel-Chromium (80 Ni-20 Cr)	E4N12		

Maximum Allowable Stress Values for Ferrous Materials, Pounds per Square Inch to Be Added to Table P-7

Spec. No.	Grade	Nominal Composition	Spec. Min. Tensile	Notes	For Metal Temperatures Not Exceeding Deg F: −20 to 100	200	300	400	−20 to 400	500	600	650	700
PIPES & TUBES													
Seamless Alloy Steel													
SA-268	TP446	27 Cr	70000	...	17500	17500	17500	17500	...	17500	17500	17500	...
FORGINGS													
Alloy Steel													
SA-182	F304	18 Cr-8 Ni	70000	(7)(13)	17500	15850	14950	14400	...	14100	13900	13850	13800
SA-182	F304	18 Cr-8 Ni	70000	(13)	17500	15850	14800	13650	...	12500	11600	11200	10800
SA-182	F321	18 Cr-8 Ni-Ti	70000	(13)	17500	17500	15850	14750	...	14200	13900	13850	13800
SA-182	F347	18 Cr-8 Ni-Cb	70000	(13)	17500	17500	15850	14750	...	14200	13900	13850	13800
SA-182	F316	18 Cr-8 Ni-3 Mo	70000	(13)	17500	17500	16700	16350	...	16050	15950	15900	15850
SA-182	F348	18 Cr-8 Ni-Cb	70000	(13)	17500	17500	15850	14750	...	14200	13900	13850	13800

Grade	For Metal Temperatures Not Exceeding Deg F: 750	800	850	900	950	1000	1050	1100	1150	1200	1250	1300	1350	1400	1450	1500
TP446	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
F304	13700	13600	13350	13050	12800	12500	10000	7500	5750	4500	3250	2450	1800	1400	1000	750
F304	10400	10000	9700	9400	9100	8800	8500	7500	5750	4500	3250	2450	1800	1400	1000	750
F321	13700	13650	13600	13600	13550	13500	13100	10300	7600	5000	3300	2200	1500	1200	900	750
F347	13700	13650	13600	13600	13550	13500	13100	10300	7600	5000	3300	2200	1500	1200	900	750
F316	15800	15650	15400	14950	14500	14000	12200	10400	8500	6800	5300	4000	2700	2000	1500	1000
F348	13700	13650	13600	13600	13550	13500	13100	10300	7600	5000	3300	2200	1500	1200	900	750

Maximum Allowable Stress Values for Ferrous Materials
Pounds Per Square Inch to be Added to Table UHA-23

Spec. No.	Grade	Type	Nominal Composition	Spec. Min. Tensile	Notes	For Metal Temperatures Not Exceeding Deg F: −20 to 100	200	300	400	500	600	650	700	750
PIPES & TUBES														
Seamless														
SA-268	TP446		27 Cr	70000	...	17500	17500	17500	17500	17500	17500	17500	...	...
FORGINGS														
SA-182	F304	304	18 Cr-8 Ni	70000	(1)(10)	17500	15850	14950	14400	14100	13900	13850	13800	13700
SA-182	F304	304	18 Cr-8 Ni	70000	(10)	17500	15850	14800	13650	12500	11600	11200	10800	10400
SA-182	F321	321	18 Cr-8 Ni-Ti	70000	(10)	17500	17500	15850	14750	14200	13900	13850	13800	13700
SA-182	F347	347	18 Cr-8 Ni-Cb	70000	(10)	17500	17500	15850	14750	14200	13900	13850	13800	13700
SA-182	F316	316	18 Cr-8 Ni-3 Mo	70000	(10)	17500	17500	16700	16350	16050	15950	15900	15850	15800
SA-182	F348	348	18 Cr-8 Ni-Cb	70000	(10)	17500	17500	15850	14750	14200	13900	13850	13800	13700
BOLTING														
SA-193	B8M	316	18 Cr-10 Ni-2 Mo	75000	(5)(7)(10)	15000	15000	13600	12650	12200	11900	11850	11800	11750

Grade	For Metal Temperatures Not Exceeding Deg F: 800	850	900	950	1000	1050	1100	1150	1200	1250	1300	1350	1400	1450	1500
TP446	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
F304	13600	13350	13050	12800	12500	10000	7500	5750	4500	3250	2450	1800	1400	1000	750
F304	10000	9700	9400	9100	8800	8500	7500	5750	4500	3250	2450	1800	1400	1000	750
F321	13650	13600	13600	13550	13500	13100	10300	7600	5000	3300	2200	1500	1200	900	750
F347	13650	13600	13600	13550	13500	13100	10300	7600	5000	3300	2200	1500	1200	900	750
F316	15650	15400	14950	14500	14000	12200	10400	8500	6800	5300	4000	2700	2000	1500	1000
F348	13650	13600	13600	13550	13500	13100	10300	7600	5000	3300	2200	1500	1200	900	750
BOLTING															
SA-193	B8M	11650	11450	11300	11100	10800	10500	10000	8500	6800	5300	4000	3000	2350	1850	1500

United Engineering Center

I GAVE

A few can say "I Gave" of my substance, of my time, and of my energy to the end that our United Engineering Center can be built and opened on schedule. These are the members who have worked Saturdays, Sundays, and holidays making personal contacts in their section, doing that which is most difficult for the average engineer, soliciting funds. One such is H. H. Cadle, who has traveled the length and the breadth of the Berkshires in Western Massachusetts, making and remaking the contacts that were necessary.

Currently we have achieved just over 91 per cent of our quota. One more section, Anthracite—Lehigh Valley, has joined the elite group of 100 per centers. Twelve other sections have improved their standing, three of them advancing into the group having less than $1000 to go. Eleven sections, while not improving their standing, continue to plug away on this project, hoping to achieve a major breakthrough.

High lights of the UEC drive to date are the achievements of two societies going over the top, namely:

AIChE	106 per cent quota
ASCE	103 per cent quota

On the ASME honor roll are these outstanding achievements:

Region V	105.3 per cent quota
Waterbury	180.8 per cent quota
N. W. Florida	95.3 per cent mem. participation

The United Engineering Center means much more to the engineering profession than a single building in which all of us make our headquarters. It is a symbol of that unity we seek, but have not quite achieved. It is a headquarters for the effective administration of the technical and educational responsibilities of our profession, so basic to the entire spectrum of Mechanical Engineering.

As professional men we must recognize these responsibilities and be willing to share that burden by supporting the ASME UEC drive.

Glass and spandrelite enclose the first ten floors of the United Engineering Center in early December, while stainless-steel mullions extend four stories higher. Only five courses of limestone remain to be placed. With recent settlement of strikes in the construction industry, threats of delay have been eliminated. With the co-operation of the 19 organizations who will occupy the Center, office layouts have been completed. Architectural details have been decided upon. Modifications have been agreed upon for heating, air conditioning, lighting, power, telephone. As a result, work for the occupants can be done as the building goes up, saving time and money.

Current Engineering: Events, News, and Comment

E. S. NEWMAN
News Editor

THE ROUNDUP

Foreign Competition Challenges the United States

NAM study reveals that foreign competition can be beneficial to our economy

FOREIGN competition can have the same helpful effects that domestic competition has, the National Association of Manufacturers said in a study prepared under the supervision of its Economic Advisory Committee, which is made up of a cross section of 27 businessmen from various sections of the country.

If the United States pursues sound economic policies at home, the industrial resurgence of other nations will be beneficial, rather than destructive, to the American economy, the NAM said.

"In fact, foreign competition can have an even more beneficial effect, since it tends to impose on our whole economy the same discipline which internal competition imposes on individual firms. We can profit by such discipline, provided we understand the lessons it teaches us and have the courage to act on them. Without such understanding and courage, foreign competition will be merely punishment instead of discipline."

Foreign Competition Is a Challenge. According to the NAM study, foreign competition should be regarded as a challenge, rather than a disaster—a challenge to "show the good sense to do the things we ought to be doing anyway." These things are:

"Removing the tax barriers to capital formation; authorizing sound depreciation policies; curbing the monopolistic powers of labor unions; and, in general, providing the kind of economic climate which is conducive to business growth and individual freedom.

"There is no sacrifice involved in doing these things," the study continued. "They will strengthen our economy and raise our standard of living.

"However, if we fail to put our house in order, the consequences for the welfare of the American economy will be serious indeed."

U. S. Standard of Living. The NAM pointed out that the United States would not have to lower its standard of living in order to meet foreign competition. "Any nation's standard of living is a reflection of the productivity of its economy," the study said. "It cannot be any other way, since there is no magic in government action or labor union action—or for that matter in business action—which will permit a nation to enjoy more goods than it produces or than it can get in return for the part of its production which it sends abroad. Foreign trade raises productivity—and hence the standard of living—because it enables a nation to concentrate its efforts on the particular types of activity in which it is most proficient."

The nations of Western Europe, and Japan, the report points out, have raised their productive efficiency to a high degree, chiefly by sticking to the principles of sound money, the free market, and the encouragement of private enterprise.

"They have shown more concern than the United States has in recent years for the control of inflation, perhaps because they have had more experience with its damaging effects," the study noted.

"They have demonstrated the kind of interest in, and ability for, technological innovation which used to be considered a special characteristic of the American economy."

U. S. Producers Meeting Tough Competition. As a result, the study said, U. S. producers are meeting intensified competition from abroad, both in domestic and in foreign markets.

Regarding Exports and Imports, for example, our total dollar exports reached a peak in 1953, declined somewhat in the recession of 1954 and 1955, and rose to a new peak in 1957 as an aftermath of the Suez crisis in late 1956. Thereafter there was a decline in exports due to the recession in 1958 and 1959. In 1960, exports are expected to increase quite sharply over the 1959 level, but they will still be somewhat below the Suez peak of 1957.

In our recent history, manufactured goods have always made up the bulk of our exports, and it is interesting to observe the movements of exports in this category. Exports of finished manufactures reached a peak of 10.9 billion dollars in 1953. In 1957 during the post-Suez period they rose to a new peak, about 8 per cent higher, but declined thereafter. In the first half of 1960, exports of finished manufactured goods ran at an annual rate of 11.8 billion dollars.

Exports Record. Thus in the seven years, 1953 to 1960, exports of finished American manufactured goods will have shown a gain of only 8 per cent. During the same period, world trade in manufactured items will have increased by about 60 per cent.

The record is much better in respect to exports of semimanufactured parts and materials. In 1960, exports of such items will be approximately two and a half times as great as in 1953. Apparently semifinished goods are being sent abroad for finishing in increasing volume.

The record of our imports shows quite different trends. Our imports of foreign finished manufactured goods have increased in virtually every year since World War II. Between 1958 and 1959 such imports increased by 33 per cent and a further increase is expected in 1960. Between 1953 and 1960 imports of finished manufactures will have increased about two and one-half times.

The growth in imports of semimanufactures has been comparatively sluggish. Over the period 1953 to 1960 such imports will have increased about in proportion to the growth of the American economy.

Thus on the export side we have been having little growth in our shipments of finished manufactures, while there has been a substantial growth in exports of semifabricated goods. By contrast, imports of finished manufactures have been rising dramatically, while imports of semifabricated products have increased only slowly.

While these facts are not conclusive they do suggest that the high cost of manufacturing in the United States lies at the root of these trends. It is becoming more advantageous to ship semimanufactured goods for final fabrication abroad, whereas importers find it increasingly advantageous to import the finished product instead of its materials or components.

It appears that exports in 1960 will be somewhat higher, and imports somewhat lower, than had been expected previously. Thus the "favorable" balance of commercial exports over commercial imports will be considerably higher than in 1958 or 1959. However, not much satisfaction can be taken in this new development, since it seems to be the result of an economic boom in Europe—stimulating our exports—coupled with sluggish economic conditions in the United States—restraining the growth in our imports. An improvement in the trade balance which depends on a comparatively sluggish performance by our own economy can hardly be considered a happy solution of the foreign competition problem. In addition, this same combination of economic circumstances has led to lower interest rates at home while those in Europe remain high.

Thus it is that short-term balances are attracted out of this country, and concern for the future strength of the dollar is intensified.

We Can Benefit From Competition. "Industries which always have had to cope with foreign competition now find their difficulties increased," the NAM said. "Other industries are meeting significant competition from abroad for the first time. Formerly we were able to depend on a sufficient excess of exports over imports to keep our international accounts in satisfactory balance. Now we are having difficulty in maintaining this position, and as a result the deficit in our balance of payments causes concern for the future stability of the American dollar."

Yet there is no intrinsic reason why the increased prosperity and productive efficiency of other parts of the world should cause damage to the United States economy, the NAM said.

"On the contrary, these developments abroad should open to us new opportunities for trade and for a broader division of labor between nations. The exchange of goods can be mutually beneficial whether those who make the exchange live in the same or in different countries, the study said.

"Whether the ultimate effects of increased productivity abroad are damaging or beneficial to us, depends in a large measure on the economic, social, and political policies we pursue. In general, we shall want to resist inflation, improve incentives, remove the barriers to investment and growth, and attain the utmost flexibility and adaptability in the American economy."

PEOPLE

Honors and Awards. R. O. Lane, Mem. ASME, vice-president in charge of research and development at the Macklin Company, Jackson, Mich., has been named an honorary member of KERAMOS, national professional fraternity of ceramic engineers, scientists, and technologists.

Major General A. M. Minton, the Air Force's Director of Civil Engineering, is the first military man to receive the District of Columbia Society of Professional Engineers annual award for outstanding contributions to the engineering profession. General Minton is a registered engineer.

Vincent D. Peery, vice-president and chief geologist of The Anaconda Company, has been named the 1961 recipient of the Jackling Award by the Society of Mining Engineers, a constituent of the AIME. He will receive the award before the Mining and Exploration Division of the Society of Mining Engineers during the AIME annual meeting, to be held from February 26 to March 2 in St. Louis, Mo.

AIME also has named Thomas E. Millsop, president and chief executive officer of National Steel Corporation, to receive its Benjamin F. Fairless Award for 1961, the presentation to be made at the annual meeting.

Peter C. Goldmark, president and director of research, CBS Laboratories, Stamford, Conn., received the engineering profession's highest honor for scientific accomplishment in the area of electronic television, the Vladimir K. Zworykin Television Prize, given by the Institute of Radio Engineers. Under Dr. Goldmark's direction, CBS Laboratories has developed aerial reconnaissance and surveillance systems for the military, and closed-circuit color television systems.

The Morris Liebmann Memorial Prize for 1961 will go to Leo Esaki, consultant at the IBM Research Lab, Poughkeepsie, N. Y., on leave from Sony Corporation, Japan. He is being honored for important contributions to the theory and technology of solid-state devices.

Other presentations for 1961 by the Institute of Radio Engineers will include the Founders Award for outstanding

Daniel Schild, **left,** chairman of the ASME Dayton Section, presents a set of ASME books to Brother Walter Roesch, head librarian at the University of Dayton, in appreciation for the University's encouraging professional societies to use the library facilities. In **right** photo, Mr. Schild presents a Certificate of Award to Richard Flanigan, Mem. ASME, immediate past-chairman of the Dayton Section.

Hendley Blackmon, Mem. ASME, president of the U. S. National Committee of the International Electrotechnical Commission, **center,** is greeted by Shri Jawaharlal Nehru, Indian prime minister. The occasion was a tea given by Prime Minister Nehru at his home, for heads of the delegations attending the 1960 IEC meetings in New Delhi. Mr. Blackmon, engineering manager of Westinghouse Electric Corporation, Pittsburgh, Pa., headed the U. S. delegation of 26 engineers. He is current chairman of the ASME Publications Committee. Mr. G. Someda, of Italy, is at **left.**

service to the society and the profession, which will go to RALPH BROWN, former Bell Telephone Laboratories scientist; and the Medal of Honor, highest technical award in the electronics field, to be given to ERNST A. GUILLEMIN, Webster Professor of electrical engineering at M.I.T.

C. V. STERNLING, engineer at Shell Development Company's Emeryville Research Center, and L. E. SCRIVEN, now at the University of Minnesota, are co-recipients of the American Institute of Chemical Engineers' Allan P. Colburn Award. This is the first time the award has been given for basic research done in the petroleum industry. The two men received the award for their paper, "Interfacial Turbulence: Hydrodynamic Instability and the Marangoni Effect."

New Officers. JAMES N. LANDIS, Fellow ASME, past-president and present Council member of the Society, is the new president of Engineers Joint Council, succeeding AUGUSTUS B. KINZEL, vice-president of Union Carbide. Mr. Landis is vice-president of the Bechtel Corporation of San Francisco.

CLIFFORD FURNAS, Mem. ASME, chancellor of the University of Buffalo, recently was elected president and chairman of the board of trustees of the Western New York Nuclear Research Center, which begins operation on campus in January.

JOHN J. HEALY, executive of the Monsanto Chemical Company, St. Louis, Mo., has been named president of the American Institute of Chemical Engineers.

LLOYD V. BERKNER, president of Associated Universities, Inc., has been elected president for 1961 of the Institute of Radio Engineers.

Appointments. ARTHUR M. PERRIN, Fellow ASME, and Director of the Society, has been appointed one of four new advisers in mechanical engineering to the board of trustees of Newark College of Engineering. He is president of National Conveyors Company, Inc., Fairview, N. J. The appointment joins him with 23 other advisers in the fields of electrical, civil, chemical, and mechanical engineering, who will inform the college and its departments on current industrial developments.

PHILIP SPORN, Hon. Mem. ASME, president of the American Electric Power Company, New York, N. Y., is one of 14 representatives from various segments of the nation's coal industry who have been appointed members of a general technical advisory committee for the Department of the Interior's Office of Coal Research. The Office of Coal Research, authorized by public law 86-599 and approved by President Eisenhower in July, 1960, will contract for, sponsor, and co-ordinate research to develop new uses for coal, and to reduce the cost of coal production and distribution. The committee will consult and assist in the evaluation of research projects.

GULIFORD L. HOLLINGSWORTH, director of the Boeing Scientific Research Laboratories, Seattle, Wash., has been appointed director of the National Science Fair, to be held at the Seattle world's fair, the Century 21 Exposition, in May, 1962. It will be the first time Seattle has hosted the fair, an annual event conducted by Science Service, Washington, D. C. National Science Fair will be held in Kansas City, Kan., in 1961.

COLONEL J. D. STRONG, USA, Ret., has been appointed field representative of the NSPE. He will assist state societies and chapters in an expanded program of orientation.

EDUCATION

New Programs

● Pennsylvania State University has announced the adoption of a four-term academic year to become effective at University Park, Pa., and at the university's 14 Commonwealth campuses with the inauguration of a ten-week summer term June 15, 1961. The new calendar is designed to speed the educational process in Pennsylvania. It has been made necessary by the mounting flood of college youth and the pressures of the times, according to president Eric A. Walker, and will utilize the university's resources on a year-around basis.

The new academic year will have four terms of ten weeks each. Class periods will be lengthened from 50 min to 75 min. However, total time spent in classes, course organization, and credit structure will remain unchanged. In 1961–1962, the summer term will extend from June 15 to August 24, followed by a fall term from Oct. 2 to Dec. 12. Winter and spring terms will extend from Jan. 3 to March 13, and March 21 to May 31, respectively. Under the new plan a student will be able to graduate in three calendar years. No change in the fee structure is contemplated.

Campus Improvements

● Expansion plans at the Newark College of Engineering, the first stage of which calls for a new academic building, a student union, a gymnasium with athletic fields, a plant operations and maintenance center, and parking facilities, have been approved by the State Department of Education. In projection for 1975, when the college is expecting an enrollment of 12,000 students, recommended campus extensions include another academic building, additions to the Tiernan Laboratory Building, a central library building, an auditorium, dormitory facilities, and additions to the 1965 student union, athletic center, and plant operations center.

● Case Institute of Technology has received a gift of $1,637,000, the largest in its history, from the Olin Foundation, Inc., for construction of an Olin Labora-

tory of Materials Sciences. The eight-story laboratory will be the tallest building on the institute grounds.

Among the major areas of materials to be studied in the building are the physical properties and behavior of polymer plastics, similarities in the behavior of these polymers and metals, the electronic properties of thin metallic films, and the basic problems of solids. The building will provide laboratories for interdisciplinary work on surface properties, living materials, experimental stresses and fatigue, organo-metallic materials, ceramics, corrosives, plastic, and laminates. It will contain a structural test laboratory, a soil physics laboratory, and laboratories for providing controlled environments for tests of behavior of matter under a wide range of conditions. A special bionics laboratory and a chemical analysis laboratory and instrumentation center will also be included.

● Cooper Union's new $4,500,000 engineering building, on the former Bible House site between Third and Fourth Avenues, Ninth Street and Astor Place, in New York City, will be formally dedicated early in 1961. It was opened to students for the first time on Oct. 17, 1960. Most of the classrooms, laboratories, and new equipment are ready for use by the 689 students of the Cooper Union School of Engineering. The building is the first major addition to the Cooper Union plant since 1912. It has 100,000 sq ft of floor space, and contains a six-story laboratory and classroom wing, a five-story office wing, and the two-story Wollman Memorial wing. It has 25 modern laboratories and workshops.

● Case Institute of Technology has received a million-dollar gift from the Leonard C. Hanna, Jr., Fund toward completion of the new Library-Humanities Center, which began construction in fall, 1959, and is expected to be in use by February, 1961.

● Another step forward in the expansion of Northeastern University's nuclear laboratory facilities was taken recently with the installation of an atomic reactor and associated equipment.

The new facilities are expected to benefit many of the strategic industries in the Boston area, since numerous Northeastern upperclass students are employed in their co-operative jobs by these industries, and since hundreds of scientists and engineers are taking postgraduate courses on a part-time basis at Northeastern.

The reactor is a subcritical assembly. It contains 5500 lb of natural uranium and 5 curies of a plutonium-berylium alloy, which acts as a source of neutrons to sustain the fission process.

One of the key pieces of equipment installed is the nuclear-reactor simulator, an electronic device constructed by Minneapolis-Honeywell Regulator Company, that produces effects identical to those in the operation of an actual nuclear reactor. This permits students to gain experience in operating a reactor without the problems inherent in the use of an actual reactor. Undergraduate seniors in chemical and mechanical engineering will initially receive instruction in the laboratory, with later extension of training planned for students in other fields.

● Polytechnic Institute of Brooklyn's new graduate center, Long Island's first graduate school of engineering, is in its first stages of construction. The facility, with attendant research laboratories, is being established at a cost of $1,600,000 on 25 acres of land located on Route 110, a half mile east of the Nassau-Suffolk border. Donated to Polytechnic by Republic Aviation Corporation, the site was formerly part of Republic's Farmingdale property. The institute has received a grant of $375,000 from the National Science Foundation to support construction.

Two buildings with a total of 65,000 sq ft of floor space will be built. Included in the main building will be twelve laboratories for research in aerospace engineering, electrical engineering, physics, and electrophysics; the second building will house three laboratories for basic research in aerodynamics and high-power electronics.

Classes are expected to begin in fall 1961. Study will be restricted to graduate work leading to the master's and doctor's degrees in full-time and part-time day and evening sessions. In addition, new master's and doctor's curriculums in electrophysics, combining the most recent work in physics, electrical engineering, and mathematics, have been approved and will be offered by Polytechnic's Microwave Research Institute.

LITERATURE

Government Publications

● "Directory of National Associations of Businessmen: 1960" a new U. S. Department of Commerce publication, contains data on more than 2000 national associations. In addition to associations of the trade type, the directory also lists about 100 societies of engineers and scientists. Of the 2000 business associations listed, about 1000 are organizations of manufacturing companies while the remainder are associations of firms engaged in construction, finance, retail trade, transportation, the service industries, and other fields. The publication became available in early November and is available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Price: 50 cents. Copies also may be ordered through one of the Department of Commerce Field Offices in 33 key cities.

● "A Compendium of Information For Use in Controlling Radiation Emergencies," (TID-8206, Rev.), contains a summary of the lecture material presented during a radiological assistance training course held in February, 1958, at Idaho Falls, Idaho, for federal, state, and armed forces personnel having responsibilities for minimizing effects of incidents involving radioactive materials. The 100-page pamphlet, which also contains a reference list of 184 publications on radiation and its control, is available from the Office of Technical Services, U. S. Department of Commerce, Washington, 25, D. C.

● "Comparison Test of Reinforcing Steels" (WT-1473) covers the results of a series of experiments on the merits of hard and intermediate-grade steel as reinforcement in concrete slabs subjected to blast loading. The experiments were part of the Plumbbob series of nuclear tests at the Nevada Test Site from May to October, 1957, and were conducted to provide additional knowledge for the construction of blast-resistant buildings. The 108-page report is available for $2.25 from the Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C.

● "Neutron Cross Section Evaluation Group Newsletter No. 1" (BNL-607-T178), which was published in June, 1960, is the first of a series of periodic summary newsletters to be issued by the Neutron Cross Section Evaluation Center at the Brookhaven National Laboratory. The center was established by the Atomic Energy Commission to act as a centralized source of information on neutron cross-section data needed by reactor engineers, designers, and physicists. Requests for information will be filled by the center on a schedule of priorities based on the general importance of the data required and their availability. The group, which is made up of experimental and theoretical physicists, also will undertake to determine the completeness of measurements on various materials. The center will issue periodic reports including reviews of existing information on,

and predictions of, nuclear cross-section properties of individual elements. Key data will be summarized in the newsletter, to be published at intervals of two to three months. The newsletter is available at 50 cents a copy from the Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C. Inquiries regarding cross-section information should be directed to Brookhaven Cross Section Evaluation Center, Building T-130, Brookhaven National Laboratory, Upton, L. I., N. Y.

NSF

Exhibit. An exhibit on "Foreign Science Literature" is available for loan to professional and academic groups. It is a fold-up book display designed to acquaint U. S. scientists and technologists with the Russian scientific literature currently being translated into English, and to inform them where these translations may be obtained. The display features sample copies of some 70 cover-to-cover translated Russian scientific and technical journals now available to American scientists in the fields of agriculture, astronomy, biology, chemistry, earth sciences, engineering, mathematics, medicine, physics, and social sciences. The exhibit also provides information on translation depository libraries in the U. S., and bibliographic periodicals that list and abstract new accessions and translated Russian literature. The display, which opens like a suitcase, and is four feet long and three and a half feet wide, is offered for two-week periods, and may be obtained upon request from the Office of Science Information Service, National Science Foundation, Washington 25, D. C.

● "Science—The Endless Frontier" is Dr. Vannevar Bush's historic 1945 report to the President on the need for an executive agency of the Federal Government to support basic research in the sciences. On the occasion of its tenth anniversary this year, the National Science Foundation is reissuing the report, which helped persuade Congress to establish the foundation. This edition contains a new foreward by Dr. Bush and a new introduction by Dr. Alan T. Waterman, director of the foundation since its inception in May, 1950. Copies may be obtained from the National Science Foundation, Washington 25, D. C.

● "Increasing the Effectiveness of Western Science" is the report of an independent study group that was formed as the result of discussions on the subject at meetings of the Science Committee of the North Atlantic Treaty Organization. The group first convened in Paris, Sept. 14, 1959, thereafter meeting periodically. The 19-page report they compiled contains suggestions for overcoming obstacles to the growth of science through greater national support and international collaboration. Additional information may be obtained through the National Science Foundation's Office of Science Information Service, Washington, D. C.

Bureau of Mines

● The U. S. Department of the Interior, Bureau of Mines is inviting proposals from companies and individuals for participation in a helium-conservation program. The bureau is sending explanatory material to more than 100 companies and persons who have expressed interest in extracting helium from natural gas for sale to the government. Among this material is a four-page leaflet, "Guidelines and Information for Prospective Participants in the Helium-Conservation Program," which lists steps under which proposals for producing helium can be sent to the bureau. Receipt of such helium information is requested by Dec. 31, 1960. Replies should be sent to the Assistant Director-Helium, Bureau of Mines, Washington 25, D. C.

NBS

● "Hydraulic Research in the United States," National Bureau of Standards Miscellaneous Publication 231, has been issued. The latest in a series dating back to 1951, it contains reports on hydraulic research conducted within the past year by various hydraulic and hydrologic laboratories in the United States and Canada. Nearly 200 subjects in the field are covered. The 190-page book costs $1; order from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

● "Standardization Activities in the United States—A Descriptive Directory," is National Bureau of Standards Miscellaneous Publication 230. In 230 pages it lists alphabetically organizations involved in standardization activities, and describes their work. Available from: Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Price: $1.75.

● "Mechanical Properties of Structural Materials at Low Temperatures—A Compilation From the Literature," National Bureau of Standards Monograph 13, has been issued to fill the need for a compilation of useful design figures. It includes tensile strength, yield strength, tensile elongations, and impact energy of about 200 materials, metallic and nonmetallic, given graphically as functions of temperature between 4 to 300 K. The 180-page book is available for $1.50 from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. (Foreign remittances to NBS must be in U. S. exchange and should include an additional one fourth of the publication price to cover mailing costs.)

AEC

● "Nuclear Reactors Built, Building, or Planned in the United States as of June 30, 1960," (TID-8200, 2nd Rev.), is a listing of all power, propulsion, production, research, and test reactors, including those for export. The 23-page pamphlet is available without charge from the Office of Technical Information Extension U. S. Atomic Energy Commission, P. O. Box 52, Oak Ridge, Tenn.

● "Fossil Fuels In The Future" (TID-8209), reviews fossil-fuel resources and, in order to estimate the earliest time when large amounts of nuclear power will be needed, forecasts the estimated rate at which they will be depleted in the absence of new sources of energy. Dealing primarily with the situation during the remainder of this century, it includes energy projections for the United States, other areas, and the world as a whole. Price: 75 cents.

I. MECH. E. MEETINGS

January 18, 1961

Pressure Vessel Research Toward Better Design, symposium, apply for registration at The Institute.

March 1, 1961

User Experience of Large-Scale Industrial Vacuum Plant, symposium, London.

→*Note:* The foregoing calendar of The Institution of Mechanical Engineers (Great Britain) meetings is published as a service to members of ASME. Further information relating to complete programs and available papers may be obtained from The Institution of Mechanical Engineers, 1 Birdcage Walk, Westminster, London, S. W. 1, England. Preliminary programs also are published in *The Chartered Mechanical Engineer* (I.Mech.E.) which is on file in the Engineering Societies Library, 29 West 39th Street, New York 18, N. Y., and other libraries throughout the United States and Canada.

Notes on Society Activities and Events

E. S. NEWMAN
News Editor

THE ASME NEWS

Sixth Annual ASME Gas Turbine Power Conference and Exhibit to Be Held in Washington, D. C.

THE sixth annual Gas Turbine Power Conference and Products Show sponsored jointly by the Gas Turbine Power Division of The American Society of Mechanical Engineers and the Department of Defense will be held in Washington, D. C., March 5–9, 1961.

The conference will be held at the Shoreham Hotel. Technical papers covering recent progress in gas turbines will be presented in several technical sessions. Papers and discussions will cover the gas-turbine fields of aircraft, automotive fuels and combustion, industrial, marine, nuclear, rail, and central station power plants.

Exhibits will be on display at both the Shoreham Hotel and on the grounds of the Pentagon. The exhibits at the Pentagon will be operating exhibits demonstrating applications of gas turbines. Among the operating exhibits are expected to be vehicles powered by gas turbines, turbine-driven marine craft and turbowater pumps. The displays at the Shoreham will be exhibited in more than 50 booths and will clearly depict the recent strides made by industry in the various gas-turbine power fields.

The exhibits at the Shoreham will be open from 11:30 a.m. to 6:30 p.m., Monday, March 6; 8:30 a.m. to 6:30 p.m., on Tuesday and Wednesday, and 8:30 a.m. to 1:00 p.m. on Thursday, March 9. The operating exhibits at the Pentagon will be on display from 12:01 p.m. to 4:00 p.m., Monday, March 6; 8:00 a.m. to 4:00 p.m., Tuesday and Wednesday, and 8:00 a.m. to 2:00 p.m., Thursday, March 9. Bus service will be provided between the Shoreham and the Pentagon.

Availability of Papers

No papers were available when this program went to press, therefore please *do not* order any papers listed in this program. The final listing of available technical papers will be found in the issue of MECHANICAL ENGINEERING containing an account of the conference. Prices are 50 cents to members of ASME, $1 to nonmembers, plus postage and handling charges. Payment may also be made by free coupons, or coupons which may be purchased from the Society in lots of ten at $4 to members; $8 to nonmembers. You can save the postage and handling charges by including your check or money order made payable to ASME with your order and sending both to: ASME Order Department, 29 West 39th Street, New York 18, N. Y. Papers must be ordered by the paper numbers, otherwise the order will be returned.

Registration may be made in advance or at the Shoreham Hotel, starting Sunday, March 5, from 3:00 to 6:00 p. m. in the West Lobby Foyer.

This conference is being arranged by the Gas Turbine Power Division of the ASME, whose chairman is J. H. Anderson, Borg-Warner Corporation, York, Pa. The Department of Defense is cosponsoring the conference, and Albert F. Bird, Chief, Transport and Ships Division, Office of Fuels, Materials and Ordnance, Department of Defense, has been appointed to co-operate in arranging the gas-turbine operating units to be exhibited at the Pentagon.

The Washington Section of the ASME is assisting in making arrangements for this conference and exhibit through its local general arrangements with J. W. Abouchar of Western Gear Corporation serving as General Chairman.

▶ MONDAY, MARCH 6

Session 1 — **9:00 a.m**

Consideration in the Development of a Maritime Gas-Cooled Reactor Plant,[1] by *B. T. Resnick*, U. S. Maritime Administration, Washington, D. C.

Sea Power: Gas Turbines Add More Fighting Punch,[1] by *R. K. James*, Chief, Bureau of Ships, Navy Department, Washington, D. C.

Session 2 — **2:00 p.m.**

The U. S. Army's Gas-Turbine Program,[1] by *G. W. Power*, Director of Developments, Office of the Chief of Research and Development, Department of the Army, Washington, D. C.

Air Force Role in Development of Turbines,[1] by *J. R. Holzapple*, Commanding General, Wright Air Development Center, Dayton, Ohio

Session 3 — **8:00 p.m.**

Combustion in Gas Turbines at Light Loads,[1] by *F. C. Mock*, engineering and research adviser, Bendix Products Div., South Bend, Ind.

Use of Experimental Stage Performance Data to Obtain Optimum Performance of Multistage Axial Compressors,[1] by *F. G. Groh* and *L. E. Brown*, Curtiss-Wright Corp., Quehanna, Pa.

Transient Temperatures and Thermal Stress Problems in Small Gas Turbines,[1] by *R. R. Van Nimw Egen*, senior group supervisor, Air Research Mfg. Co., Phoenix, Ariz.

▶ TUESDAY, MARCH 7

Session 4 — **9:00 a.m.**

A Gas-Turbine "CO" Boiler Installation; Economic and Thermodynamic Analysis,[1] by *C. Bultso*, senior mechanical engineer, Humble Oil and Refining Co., Baytown, Texas

The Coal-Burning Closed-Cycle Gas Turbine,[1] by *Curt Keller*, director of R&D, Escher Wyss, Ltd., Zurich, Switzerland

Practical Realizations of Gas Turbines Combined With Steam and Industrial Heat Cycles,[1] by *W. Auer*, chief engineer, Gas Turbine Application and Sales Department, Brown Boveri Company, Ltd., Baden, Switzerland

Session 5 — **2:30 p.m.**

Standby Power for Hydro-Quebec Uses Gas-Turbine Generators,[1] by *D. F. Abel*, specialist-turbine sales, Canadian General Electric Co., Ltd., Peterborough, Ont.; and *H. W. Haberl*, assistant chief engineer, Quebec Hydro Electric Commission, Montreal, Que.

Gas-Turbine Operating Experience at Orlando,[1] by *C. H. Stanton*, general manager, Orlando Utilities Commission, Orlando, Fla.

Application and Operating Experience of Gas Turbines Used as Hot-Air Generators,[1] by *J. W. Kirkpatrick*, manager, Turbo Products Engineering Department, Clark Brothers Co., Olean, N. Y.

▶ WEDNESDAY, MARCH 8

Session 6 — **9:00 a.m.**

Materials Keep Pace With Industrial Gas-Turbine Needs,[1] by *H. B. Gayley*, metallurgical engineer, Gas Turbine Department, Westinghouse Electric Corp., Lester, Pa.

Segregated Structures in Highly Alloyed Ferritic Gas-Turbine Wheel Forgings,[1] by *A. W. Herbener* and *G. R. Heckman*, manager and engineer, General Electric Co., Schenectady, N. Y.

Wheel Spinning,[1] by *B. O. Buckland*, consulting engineer, General Electric Co., Schenectady, N. Y.

Session 7 — **2:30 p.m.**

Design and Development Review of the T64 Turboprop/Turboshaft Engine,[1] by *F. F. Ehrich*, T64 engine design engineer, General Electric Co., SAED, West Lynn, Mass.

Shipboard 750-Kw. Gas-Turbine Generator Set,[1] by *H. P. Karen*, project engineer, Solar Aircraft Co., San Diego, Calif.

A 7500 Shp Gas Turbine for Naval Boost Propulsion,[1] by *F. R. Harris*, chief engineer, Gas Turbine Department, Turbine Generator Division, Associated Electrical Industries (Manchester) Ltd., Manchester, England

▶ THURSDAY, MARCH 9

Session 8 — **9:00 a.m.**

Operating of 8500-Hp Gas Turbines in Locomotive Service,[1] by *H. Rees*, senior mechanical engineer, Union Pacific Railroad Co., Omaha, Neb.

Report on Progress With The Copper Bessemer RT-248 Gas Turbine,[1] by *R. L. Boyer*, vice-president and director of engineering, The Cooper-Bessemer Corp., Mount Vernon, Ohio

Pratt & Whitney Industrial Engineering,[1] by *W. J. Closs*, manager—Industrial Power Department, Pratt & Whitney Aircraft, East Hartford, Conn.

[1] Paper not available—see box on this page.

MEETINGS OF OTHER SOCIETIES

● IN THE UNITED STATES

January 17–19

Instrument Society of America, winter instrument-automation conference and exhibit, Sheraton-Jefferson Hotel, and Kiel Auditorium, St. Louis, Mo.

January 18

AIME, third mechanical working conference, Bar and Shaped Products, Penn-Sheraton Hotel, Pittsburgh, Pa.

January 23–25

Institute of the Aeronautical Sciences, national annual meeting, Hotel Astor, New York, N. Y.

January 23–26

American Meteorological Society, 41st annual meeting, Barbizon-Plaza Hotel, New York, N. Y.

January 23–26

Plant Maintenance and Engineering conference and show, International Ampitheatre, Chicago, Ill.

January 24–27

Society of Plastics Engineers, annual technical meeting, Shoreham and Park Sheraton Hotels, Washington, D. C.

January 29–February 3

AIEE, winter general meeting, Statler-Hilton Hotel, New York, N. Y.

January 30–February 3

ASTM, committee week, Netherland Hilton Hotel, Cincinnati, Ohio.

February 2–3

Illinois Institute of Technology, industrial management engineering conference, Chicago, Ill.

February 9–11

National Society of Professional Engineers, winter meeting, Hotel Fort Des Moines, Des Moines, Iowa.

February 13–16

ASHRAE, fifteenth international heating and air-conditioning exposition and semi-annual meeting, Conrad Hilton Hotel, Chicago, Ill.

● IN EUROPE

April 17–19

International Meeting on Fluid Sealing, sponsored by the British Hydromechanics Research Association, Grosvenor Hall, Ashford, Kent, England.

May 2–9

Sixth international packaging exhibition, organized by N. V. 't Raedthuys, to be held in the R.A.I. exhibition halls, Amsterdam, the Netherlands.

May 15–19

The Institute of Fuel, conference on waste heat

recovery from industrial furnaces, Bournemouth, England.

July 30–August 6

International Symposium on the Durability of Concrete, prepared by the Czechoslovak Academy of Sciences, Institute of Theoretical and Applied Mechanics, within the framework of The Permanent Committee of Réunion Internationale des Laboratoires d'Essais et de Recherches sur les Matériaux et les Constructions (RILEM); to be held in Prague.

● IN CANADA

October 19–November 7

The Iron and Steel Institute, special meeting in the U. S. and Canada.

● IN MEXICO

March 2–12

Third Inter-American Management Conference, on Scientific Management and its Responsibility for Bettering the Standard of Living of the Americas, organized by the Confederación Patronal de la República Mexicana, Mexico City.

(*For ASME Coming Events see page 149.*)

Limitless Flight Is Theme of ASME Los Angeles Aviation Conference, March 12–15

"LIMITLESS FLIGHT" is the theme of the forthcoming ASME Aviation Conference sponsored by the Aviation Division of The American Society of Mechanical Engineers. The conference will be held March 12–15, 1961 at the Hotel Statler Hilton in Los Angeles, Calif.

Among the 25 technical sessions, such topics as structural design, production techniques, reliability, guidance and instrumentation, accessory equipment, space transports, air transports, and propulsion will be discussed.

One of the conference high lights includes the presentation of the Spirit of St. Louis Award. Also scheduled is a field trip to a ramjet-engine test site.

▶ MONDAY, MARCH 13

Structural Design, Production Techniques, and Reliability 1 — 9:30 a.m.

Dynamic Balancing of Missiles and Space Probe,[1] by *D. A. Lee* and *Mr. Switz*, Space Technology Labs., Inc., Los Angeles, Calif.

Gust Alleviation in the Modern Airplane,[1] by *G. M. Andrew* and *F. H. Gardner*, North American Aviation, Inc., Downey, Calif.

High-Intensity Acoustics Facility for Environmental Testing of High-Performance Vehicle,[1] by *D. C. Skilling*, Norair, Hawthorne, Calif.

The Response of a Uniformly Damped Cantilever Beam to a Random in Time Force,[1] by *G. W. Painter*, Lockheed Aircraft Corp., Burbank, Calif.

Structural Design, Production Techniques, and Reliability 2 — 9:30 a.m.

Stability of Honeycomb Sandwich Cylinders Under Axial Compression, External Lateral Pressure and Torsion,[1] by *M. O. Kiciman* and *D. Y. Konishi*, North American Aviation, Inc., Los Angeles, Calif.

Elastic Properties of Orthotropic Momofilament Laminates,[1] by *J. C. Ekvall*, Lockheed Aircraft Corp., Burbank, Calif.

Ausform Steels, Ultra-High Strength Materials for Lightweight Rocket Casings,[1] by *S. T. Ross*, Aeronutronic, Newport Beach, Calif.

Evaluation of the Short Time Mechanical Properties of Structural Beryllium,[1] by *E. C. Bernett*, Marquardt Corp., Van Nuys, Calif.

Space Transport 1 — 9:30 a.m.

Design Considerations for Condensation Under Exterrestrial Environment—Critical Review of Theory,[1] by *R. J. Grosh* and *Y. S. Tang*, General Motors Corp., Indianapolis, Ind.

Radiant Interaction Between Fin and Base Surfaces,[1] by *E. M. Sparrow*, Univ. of Minnesota, Minneapolis, Minn.

Design Criteria for a Thermal Space Simulator,[1] by *A. Lengtel, D. J. Santele*, and *P. A. Marfone*, General Electric Co.

Guidance and Instrumentation 1

The Disciplined Geometry of Micromodules Yields Practical Miniaturization,[1] by *J. W. Knoll*, Radio Corporation of America, Camden, N. J.

A New Mechanical Approach in the Construction of Modular Electronic Equipments,[1] by *R. C. Swengel* and *W. R. Evans*, AMP, Inc., Harrisburg, Pa.

Thermal Design for Microminiaturized Circuit,[1] by *H. C. Kammerer*, IBM Corp., Kingston, N. Y.

Structural Design, Production Techniques, and Reliability 3 — 2:30 p.m.

Titan Testing,[1] by *J. R. Cook*, The Martin Co., Denver, Colo.

Facility Design for Combined Environmental Testing of Rocket Propulsion Components,[1] by *R. J. Thoreson*, Edwards Air Force Base, Calif.

Advanced Fabrication Techniques,[1] by *Joseph Glyman* and *Edward Green*, Rocketdyne Div., North American Aviation, Inc., Canoga Park, Calif.

Structural Design, Production Techniques, and Reliability 4 — 2:30 p.m.

The Optimum Structural Design of Manned Spacecraft,[1] by *D. G. Younger*, Aeronutronic, Newport Beach, Calif.

Improvement of Fatigue Life of Aircraft Components by Coining,[1] by *A. Phillips*, Douglas Aircraft Co., Santa Monica, Calif.

High-Strength Landing Gear Forgings—The Manufacture of Ductile Components From Air Melted Steels,[1] by *R. L. Roshong*, Cameron Iron Works, Houston, Texas

Application of the Stiffness Method to the Analysis of Steel Structures,[1] by *B. E. Greene, R. C. Weikel*, and *D. R. Strome*, Boeing Airplane Co., Seattle, Wash.

Guidance and Instrumentation 2 — 2:30 p.m.

A Micromodule Missile Autopilot,[1] by *J. H. Porter*, RCA West Coast Missile and Surface Radar, Van Nuys, Calif.

Mechanical Reliability,[1] by *J. W. Schreiber*, Ling Electronics, Anaheim, Calif.

The Use of Derivative Pressure Feedback in High-Performance Hydraulic Servomechanism,[1] by *D. W. Wilson* and *T. R. Welch*, Hughes Aircraft, Culver City, Calif.

Pattern of Failure on Guidance and Instrumentation Equipment,[1] by *R. L. Horn*, Boeing Aircraft, Wichita, Kan.

Space Transport 2 (Satellite Heat Transfer) — 2:30 p.m.

A Space Thermal Simulator,[1] by *E. N. Borson*, Northrup Corp., Hawthorne, Calif.

Comparison of Analytical and Experimental Local Heat Fluxes in Liquid Propellant Rocket Thrust Chambers,[1] by *W. E. Welsh, Jr.*, California Inst. of Techn., Pasadena, Calif.

An Analysis of Transpiration Cooling in a Thermal Arc Jet,[1] by *K. Sato*, Aerojet-General Corp., Azusa, Calif.

Comparison of Numerical Methods Employed to Calculate Transient Temperatures During Re-Entry,[1] by *L. H. Johnson*, TEMCO Missiles and Aircraft Corp., Dallas, Texas

▶ TUESDAY, MARCH 14

Air Transport 1 — 9:30 a.m.

Simulation Past and Present,[1] by *Jack E. Ekstromer*, Douglas Aircraft Co., Inc., Santa Monica, Calif.

Training Accessories[1] by *W. N. Staynes*, Redifon, Ltd., Crawley, Sussex, England

Delivery Before First Aircraft,[1] *L. L. Kelly* General Precision, Inc., Binghamton, N. Y.

Inherent Problems[1], by *R. J. Yates*, Quantas Empire Airways, Ltd., Burbank, Calif.

Problem Corrections,[1] by *H. B. Crockett*, Lockheed Aircraft Corp., Burbank, Calif.

Transition Training,[1] by *R. F. Rowe*, Trans World Airlines, Inc., Kansas City, Mo.

Proficiency Checks,[1] by *J. R. Gannett*, Boeing Airplane Co., Renton, Wash.

FAA Approvals,[1] by *Jack Hudson*, Federal Aviation Agency, Washington, D. C.

Accessory Equipment 1 — 9:30 a.m.

Development of a High-Power Solar Mechanical Engine, by *B. T. Macauley*, Sundstrand

Aircraft Hydraulic Pump/Motor—New Developments Presage Increased Utility and Applications,[1] by *F. L. Moncher* and *R. P. Lambeck*, Vickers, Inc., Detroit, Mich.

Temperature Control of Centaur's Oxidizer Tank During Coast Periods,[1] *A. M. Pope*, Convair Astronautics, San Diego, Calif.

Propulsion 1 — 9:30 a.m.

The Application of the Gas Turbine to Ground Cushion Vehicles,[1] by *A. P. Kelley* and *L. W. Norman*, AiResearch Mfg. Co. of Arizona, Phoenix, Ariz.

Development of a Small Gas Turbine Engine for Helicopter Propulsion,[1] by *P. W. Pichel*, Solar Aircraft Co., San Diego, Calif., and *J. V. Ryan*, Gyrodyne Co., of America, Inc., St. James, L. I., N. Y.

[1] Paper not available—see box on this page.

Availability of Papers

No papers were available when this program went to press, therefore, please *do not* order any papers listed in this program. The final listing of available technical papers will be found in the issue of MECHANICAL ENGINEERING containing an account of the conference. Prices are 50 cents to members of ASME, $1 to nonmembers, plus postage and handling charges. Payment may also be made by free coupons, or coupons which may be purchased from the Society in lots of ten at $4 to members; $8 to nomembers. You can save the postage and handling charges by including your check or money order made payable to ASME with your order and sending both to: ASME Order Department, 29 West 39th Street, New York 18, N. Y. Papers must be ordered by the paper numbers otherwise the order will be returned.

The Development of the Allison T63 Engine,[1] by *J. M. Wetzler*, General Motors Corp., Indianapolis, Ind.

Structural Design, Production Techniques, and Reliability 9:30 a.m.

Integral Pressure Welding Techniques,[1] by *L. E. Gatzek* and *Ivan Rattinger*, Space Technology Labs., Inc., Los Angeles, Calif.

Explosive Metal Forming Comes of Age at Aerojet,[1] by *G. C. Throner*, Aerojet-General Corp., Downey, Calif.

Forming of High-Temperature Materials,[1] by *I. J. Wilson*, North American Aviation, Inc., Los Angeles, Calif.

New Joining Processes for Uncommon Materials,[1] by *R. E. Monroe*, Battelle Memorial Inst., Columbus, Ohio

Air Transport 2 (Flight Simulator—Advanced Training Requirements for Tomorrow's Needs) 2:30 p.m.

Advanced Requirements,[1] by *J. G. Brown*, United Air Lines, Denver, Colo.

New Techniques,[1] by *R. C. Dehmel*, Curtiss-Wright Corp., East Patterson, N. J.

Increased Fidelity,[1] by *W. Makinson*, General Precision Systems, Ltd., Buckinghamshire, England

Critical Areas,[1] by *M. J. van den Oever*, KLM-Royal Dutch Airlines, Schiphol Airport, Holland

Next Aircraft Phase,[1] by *W. D. Davis*, Dalto Corp., Norwood, N. J.

Future FFA Approvals,[1] by *J. W. Hudson*, Federal Aviation Agency, Washington, D. C.

Military Utilization,[1] by *A. P. Pawluk*, Strategic Air Command, Offutt AFB, Neb.

Space Technology,[1] by *G. L. Murphy*, Douglas Aircraft Co., Inc., Santa Monica, Calif., and *G. A. Rathert, Jr.*, NASA

Accessory Equipment 2 2:30 p.m.

A Family of Solar-Space-Power Systems Based on the Sunflower Concept,[1] by *C. J. Daye, V. P. Kovacik* and *J. A. Rudy*, Thompson Ramo Wooldridge, Inc., Cleveland, Ohio

Hydraulic System for B-52 Towing Vehicle Transmission,[1] by *Otto Byers*, Vickers, Inc., Waterbury, Conn.

Use of Cryogenic Hydrogen to Provide Cooling, Power, and Thrust for Space Vehicles,[1] by *J. I. Mason* and *W. L. Burriss*, AiResearch Co., Inc., Los Angeles, Calif.

The Use of Large Butterfly Valves in Modern Wind Tunnels,[1] by *J. C. McLane, Jr.*, U. S. Army Engineer District, Tullahoma, Tenn.

Space Transport 3 (Zero Gravity Problems) 2:30 p.m.

Zero-Gravity Problems in Space-Power Plants: A Status Survey,[1] by *W. Unterberg* and *J. T. Congelliere*, Rocketdyne Div., Canoga Park, Calif.

Space Storage of Cryogenic Propellants,[1] by *F. R. Cleveland*, Aerojet-General Corp., Azusa, Calif.

Experimental Determination of Some Moments of Inertia of Man,[1] by *H. S. Alexander* and *J. T. Celentano*, North American Aviation, Downey, Calif.

Propulsion 2 (Elevated Temperature Problems Associated With the Small Gas Turbine) 2:30 p.m.

High-Temperature Alloys for Small Gas-Turbine Application,[1] by *Murray Kaufman*, General Electric Co., West Lynn, Mass.

Gas-Turbine Component Designs to Optimize Material Capabilities,[1] by *R. M. Titus* and *N. R. Griswold*, Boeing Airplane Co., Seattle, Wash.

Vibration Analysis of Small Gas-Turbine Blades,[1] by *R. Hohenberg*, Avco Corp., Stratford, Conn.

Structural Design, Techniques, and Reliability 6 2:30 p.m.

On Thermal Stresses in Cylinders Subjected to Gamma-Ray Heating,[1] by *N. A. Weil*, Armour Research Foundation, Chicago, Ill.

Composite Material Structures for Re-Entry Vehicle Applications,[1] by *E. W. Blocher, Jr., R. L. Johnson*, and *E. D. Weisert*, Marquardt Corp., Van Nuys, Calif.

Thermal Stress in Circumferentially Constrained Thick-Walled Cylinders and Solid Spheres,[1] by *Walter Unterberg*, Rocketdyne, Canoga Park, Calif.

[1] Paper not available—see box on page 147.

▶ WEDNESDAY, MARCH 15

Accessory Equipment 3 (Environmental Control) 9:30 a.m.

A Discussion of the Operation of the X-15 Environmental Control System,[1] by *Daniel Westbrook*

Design Features of a Cabin Air Turbocompressor for a Transport Airplane,[1] by *W. W. Thayer*, Douglas Aircraft Co., Santa Monica, Calif.

Adverse Weather-Systems Development for the Convair 880/606 Jet Transports,[1] by *D. T. Bowden*, General Dynamics Corp., San Diego, Calif.

Lightweight Thermal Insulation by Transpiration Cooling,[1] by *J. G. Krisilas* and *J. E. Boberg*, Lockheed Aircraft Co., Burbank, Calif.

Space Transport 4 (Missile Logistics and Ground Support) 9:30 a.m.

On the Development of Launchers for Low-Acceleration, Multinozzle Missiles,[1] by *A. N. Baxter, Jr.*, Space Technology Labs., Inc., Los Angeles, Calif.

Storage, Logistics Supply, and Pumping of High-Pressure Liquid Helium,[1] by *J. W. Marshall*, Edwards AFB, Calif.

Logistic Missiles, Application, and Development,[1] by *H. Nakamura* and *S. A. Milliken*, Convair, San Diego, Calif.

Propulsion 3 (Space Propulsion Vehicle Systems) 9:30 a.m.

The Influence of Specific Impulse and Propellant Mass Fraction on the Effective Performance of Advanced Solid Propulsion Systems,[1] by *I. S. Florman*, Rocketdyne Div. of North American Aviation, Inc., Canoga Park, Calif.

New Possibilities in Electrical Propulsion—Molecular and Colloidal Ions,[1] *A. Lucile Cox*, Rocketdyne Div. of North American Aviation, Inc., Canoga Park, Calif.

Structural Design, Production Techniques, and Reliability 7 9:30 a.m.

Measurement of Four-Pole Parameters of Complex Structures,[1] by *F. B. Safford*, Nortronics Division of Northrop Corp., Hawthorne, Calif.

Application of Four-Pole Parameters to Rotational Vibration Problems,[1] by *C. T. Molloy*, Space Technology Labs., Inc., Los Angeles, Calif.

Automation in Random Vibration Testing,[1] by *Wayne Tustin*, MB Electronics, New Haven, Conn.

Analysis and Solution of Vibration Problems in Hughes Model 269A Helicopter,[1] by *F. C. Strible* Hughes Tool Co., Culver City, Calif.

Accessory Equipment 4 (Environmental Control) 2:30 p.m.

Catalytic Filtration of Ozone in Airborne Application,[1] by *J. E. Boberg* and *M. Levine*, Lockheed Aircraft Co., Burbank, Calif.

The North American Aviation, Inc., A3J-1 Airplane. Spin and Recovery Simulation on the Aviation Medical Acceleration Laboratory Human Centrifuge,[1] by *Robert Snyder*, U. S. Naval Air Development Center, Johnsville, Pa.

Environmental Conditioning of the Volkyrie, B-70,[1] by *Earl Adams*, United Aircraft Corp., Windsor Locks, Conn.

Mechanical Refrigeration for a Lunar System,[1] by *D. B. Mackay*, North American Aviation, Inc., Downey, Calif.

Space Transport 5 2:30 p.m.

Space Vehicle Systems Engineering and Ground Support,[1] by *J. D. Blaisdell*, Space Technology Labs., Inc., Los Angeles, Calif.

Predicting Field Life Expectancies of Elastomers in Missile Systems,[1] by *J. S. Chandler*, Chrysler Corp., Detroit, Mich.

Maintainability as a Design Characteristic of Equipment,[1] by *J. Sahs*, Chrysler Corp., Detroit, Mich.

Propulsion 4 (Advanced Aero-Turbo Design) 2:30 p.m.

Cavitation Characteristics of Tank-Mounted Centrifugal-Type Cryogenic Pumps,[1] by *J. F. DiStefano* and *J. O. Panosian*, Borg-Warner Corp., Bedford, Ohio

Control of Supersonic Inlets,[1] by *T. A. Flanders*, Hamilton Standard, Windsor Locks, Conn.

A Study of the Limitations of Air-Breathing Thermal Engines at Extremes of Altitude and Velocity,[1] by *C. A. Sarro*, Grumman Aircraft Eng. Corp., Bethpage, L. I., N. Y.

Structural Design, Production Techniques, and Reliability 8 2:30 p.m.

Elevated-Temperature Stress-Rupture and Fatigue Properties of Inconel and Inconel X in Ammonia Atmospheres,[1] by *M. H. Weisman*, North American Aviation, Inc., Los Angeles, Calif.

Structural Characteristics of Fasteners for Honeycomb,[1] by *J. Cherne*, Shur-Lok Corp., Anaheim, Calif.

Method of Calculating Residual Stresses in Formed Parts,[1] by *C. S. Yen*, Douglas Aircraft Co., Santa Monica, Calif.

1961 RAC Meetings Schedule

Date	Days	Location	Hotel	Region	Section
March 27–28	Mon.-Tues.	Lancaster, Pa.	Stevens House	III	Susquehanna
Apr. 4–5	Tues.-Wed.	Tulsa, Okla.	Ramada Inn Motel	X	Mid-Continent
Apr. 7–8	Fri.-Sat.	Seattle, Wash.	Edmund Meany	IX	Western Washington
Apr. 15–16	Sat.-Sun.	Atlanta, Ga.	Henry Grady	IV	Atlanta
Apr. 19–20	Wed.-Thurs.	Denver, Colo.	Denver-Hilton	VIII	Rocky Mountain
Apr. 21–22	Fri.-Sat.	Kansas City, Mo.	Muehlebach	VII	Kansas City
Apr. 24–25	Mon.-Tues.	Dayton, Ohio	Van Cleve	V	Dayton
Apr. 28–29	Fri.-Sat.	Louisville, Ky.	Sheraton	VI	Louisville
May 1–2	Mon.-Tues.	Suffern, N. Y.	Motel on the Mountain	II	North Jersey
May 5–6	Fri.-Sat.	Waterbury, Conn.	Roger Smith	I	Waterbury
Palm Sunday	March 26				
Good Friday	March 31				
Easter Sunday	April 2				

Civic Arena in Pittsburgh, Pa., showing telescoping domed roof which can be "nested" so that most of amphitheater within is canopied by the sky and stars. Pittsburgh will be the scene of the 1961 ASME Metals Engineering Conference, April 23–26. The theme: "Tailoring Metals to Engineering Design Requirements."

"Tailoring Metals to Engineering Design Requirements"—Topic at Upcoming ASME Metals Engineering Conference

THE Pittsburgh Section of The American Society of Mechanical Engineers will be host for the 1961 Metals Engineering Division Conference to be held in the Penn-Sheraton Hotel, April 23 to 26. It is quite appropriate that the Conference will be held in Pittsburgh, "The City of Steel," with the Golden Triangle and home of the much publicized Civic Arena with the telescoping, segmented, all-steel domed roof.

Conference theme will be "Tailoring Metals To Engineering Design Requirements." Present plans are to present some twelve papers during the three-day meeting. The papers will be authored by prominent engineers and scientists in the metals field. One portion of the program will be devoted to current metals problems in atomic energy, problems confronting industry and the military. Other sessions of the meeting will view the direction of present research work in steel and the trend of research in refractory, high-temperature, and nonferrous metals.

The meeting will feature two luncheons, at one of which ASME President W. H. Byrne has been invited to speak. Dr. Patrick Lang will address the second luncheon group on the subject of "The Use of Metal Implants in Surgery."

T. W. Eichelberger of Westinghouse Electric Corporation Research Laboratories is arranging the conference program for the Division with the assistance of C. B. Cochran, Peter F. Loftus Corporation, vice-chairman of the Pittsburgh Section. Others serving on the general arrangements committee are H. H. Hauth, Babcock & Wilcox Company, chairman of Pittsburgh Section; S. Vajda, Jones and Laughlin Steel Company; J. H. Daugherty, T. J. Barry Company; H. I. Shakeshaft, Jr., General Electric Company; W. N. Johnson, Ingersoll Rand Company; J. R. Aikins, Gulf Research and Development Company; J. W. Stubenbort, Consolidation Coal Company; and K. E. Atwood, Bailey Meter Company.

Inquiries should be addressed to T. W. Eichelberger, Westinghouse Research Laboratories, Beulah Road, Pittsburgh 35, Pa.

ASME COMING EVENTS

March 5–9, 1961
ASME Gas Turbine Power Conference and Exhibit, Shoreham Hotel, Washington, D. C.

March 12–15, 1961
ASME Aviation Conference, Statler Hilton Hotel, Los Angeles, Calif.

March 16–17, 1961
ASME Textile Engineering Conference, Clemson College, Clemson, S. C.

April 6–7, 1961
ASME-SAM Management Engineering Conference, Statler Hilton Hotel, New York, N. Y.

April 9–13, 1961
ASME Oil and Gas Power Conference and Exhibit, Jung Hotel, New Orleans, La.

April 10–11, 1961
ASME Maintenance and Plant Engineering Conference, Bancroft Hotel, Worcester, Mass.

April 20–21, 1961
ASME-AIEE Railroad Conference, Sir Francis Drake Hotel, San Francisco, Calif.

April 23–26, 1961
ASME Metals Engineering Conference, Penn-Sheraton Hotel, Pittsburgh, Pa.

May 7–10, 1961
ASME-EIC Hydraulic Conference, Queen Elizabeth Hotel, Montreal, Que., Canada.

May 8–9, 1961
Lubrication Symposium, Deauville Hotel, Miami Beach, Fla.

May 10–12, 1961
ASME Production Engineering Conference, Royal York Hotel, Toronto, Ont., Canada

May 22–25, 1961
ASME Design Engineering Conference and Exhibit, Cobo Hall, Detroit, Mich.

June 11–14, 1961
ASME Summer Annual Meeting, Statler Hilton Hotel, Los Angeles, Calif.

June 14–16, 1961
ASME Applied Mechanics Conference, Illinois Institute of Technology, Chicago, Ill.

August 28–September 1, 1961
Second International Heat-Transfer Conference, University of Colorado, Boulder, Colo.

September 14–15, 1961
ASME-AIEE Engineering Management Conference, Hotel Roosevelt, New York, N. Y.

September 24–27, 1961

ASME-AIEE National Power Conference, St. Francis Hotel, San Francisco, Calif.

September 24–27, 1961

ASME Petroleum Mechanical Engineering Conference, Muehlebach Hotel, Kansas City, Mo.

October 4–6, 1961

ASME Process Industries Conference, Shamrock Hilton Hotel, Houston, Texas

October 17–19, 1961

ASME-ASLE Lubrication Conference Morrison Hotel, Chicago, Ill.

November 26–December 1, 1961

ASME Winter Annual Meeting, Statler Hilton Hotel, New York, N. Y.

(For Meetings of Other Societies, see page 148.)

Note: Persons wishing to prepare a paper for presentation at ASME National meetings or Division conferences should secure a copy of Manual MS-4, "An ASME Paper," by writing to the ASME Order Department, 29 West 39th Street, New York 18, N. Y. Price to nonmembers, 50 cents; to ASME members, free. Also available on request is a "Schedule of Program Planning Dates for Meetings and Publication Deadline Dates." Ask for Form M&P 1315.

Conducted for the National Junior Committee

J.W. FOLLANSBEE[1]

JUNIOR FORUM

1960 ASME Winter Annual Meeting: Junior Session Covers Aids to Professional Development

THE Junior Session of the 1960 ASME Winter Annual Meeting was held on November 30. Chairman Robert J. Heinzman and Vice-Chairman Albert S. Goldstein, both of Ithaca, New York, headed the meeting. Speakers were George E. Moore, Manager of Graduate Student Training, Westinghouse Electric Corp., Pittsburgh, Pa.; Sheldon Meyers, Manufacturing Engineering Department, Grumman Aircraft, Long Island, New York; and William M. Morley, Sales Engineer, Stock Equipment Company, Cleveland, Ohio.

The main question covered at this session was: "How to Help the New Graduate Get Started." The three speakers covered the ECPD (Engineers' Council for Professional Development), "Why the Young Engineer Needs Aid," and "Benefits I Derived From ASME."

Development Aids. During his talk, Mr. Moore raised the point that some new graduates are hoodwinked into jobs with initially high-paying salaries, but which have little or no future because of extreme specialization or some other restrictive situation. Even though the job may continue to exist, from then on the paths to bigger jobs are narrow and many dead-end. Then, some jobs even stop existing and the jobholder has to start anew.

He felt all prospective graduates should make a much more thorough job analysis before leaving school than most students now do. Here he went into the ECPD and how this committee can aid both pre and postgraduate development.

Mr. Moore touched on each of the main six points that make up the credo of ECPD. They are: (1) Orient yourself to the job; (2) integrate with your community; (3) develop your own program of technical and nontechnical reading; (4) work out a way to self-evaluation; (5) create a professional identification; and (6) professional registration.

Need for Aid. Sheldon Meyers followed up Mr. Moore's comments with the question: "Why Does the Young Engineer Need Aid in Professional Development?" His answer: Help is needed to cut the time that bridges the gap between the novice and experienced engineer. Mr. Meyers said that the next few years would be more important for engineers than the past 20, both from the standpoint of increased work here in the United States and from economic competition from abroad.

One way to help meet the importance of this situation is to cut the lead time between beginning and experience. Mr. Sheldon then brought up four reasons for belonging to a professional engineering society: (1) Contact—to gain knowledge, not of big jobs or the boss's daughter (schools are turning out more engineers than the bosses are daughters); (2) scope—to help overcome specialization; (3) self-expression—both in the society and with others at work; (4) place to test ideas and theories—in conversations and talks you can get reaction to your theories that you could not get at work.

Finally, Mr. Meyers touched on finances. With many young engineers in the married group, the costs of belonging to a society, attending meetings, having meals with associates, etc., are too much to carry. Lots of times the little woman puts her foot down and says—No! Since this is a personal matter, you won't hear the problem openly discussed frequently. Yet, it is very real with thousands of new engineers.

One path to follow in winning over the wife's approval of putting society expenses into the budget is to chalk them up as part of your education expense. Treat them as a capital investment. The returns will come, but only after a few years. Since it is a long-term investment, you can't expect to reap benefits immediately. Mr. Meyers recommended this idea to some younger engineers he knows and found it worked well in many cases.

ASME Benefits. William M. Morley wrapped up the formal talks with one on the benefits he derived from ASME. Mr. Morley worked his way up through the ranks of the National Junior Committee to become Chairman of the group during 1959. He mentioned benefits don't come with the dues, but that you get out of the society what you put into it. This is an old saw but it applies almost anywhere. Those things that you want and that you get through your own efforts have the most value to you. This applies to ASME as well as other areas.

Most of the benefits are intangible, yet are very real. Gain in assurance, in the continual meeting of new people and new friends, knowledge gained from others—all these add up to being worth the effort.

[1] Designer, Voorhees, Walker, Smith, Smith & Haines, New York, N. Y. Assoc. Mem. ASME.

The Forum. After the talks, the panelists threw the meeting open to questions and comments from the floor. Robert Eton of Ford Instrument Company commented that the knowledge a young man brings from meetings, both local and national, is worth money to that man in, say, the form of higher salary. George Moore answered that the meetings often get you away from the job for a few days and help you get a better perspective on problems at the plant. Sheldon Meyers thought employers should let the engineers and others at the plant know the bosses are interested in society meetings.

William Morley said one problem is to get young men to give up a Saturday or weekend to go to National Junior Committee meetings. Companies generally won't finance these trips. So the double problem of time and money looms large both for national and local meetings.

Ted Stevenson of Atlantic Sugar Refinery stated that societies often form on the odd chance they will benefit member companies. (He was speaking of societies of a highly specialized nature, such as sugar refining, pulp and paper, petroleum, etc., not the ASME.) Here companies encourage membership, pay dues, help with expenses. On social contact, Ted thought engineers should talk more with nonengineers. George Moore was against company-paid dues and other expenses. He thought this tended to put undue pressure of obligation to the employer on the member, and restricted his ability to speak out freely against company policies or other possibly controversial matters in society meetings.

The student aides questioned the value of the co-op program. And, there was immediate disagreement among everybody, both panel members and audience. Some felt the six years generally involved was too long. Others felt the experience gained was more than a regular five-year course plus the first year of work. The main thought seemed to be that it was up to the student to determine what he wanted—experience as he learned theory, or experience later. He should then decide and follow his decision to completion.

This meeting evolved one predominant idea: Society and outside social activities give back in one form what you, as a member, put forth in another. The gains are largely intangible, yet real and realizable—new friends, added knowledge, greater assurance in dealings with people. There is a money gain; but it is difficult to trace this directly to society activities.

Keep Your ASME Records Up to Date

The ASME Secretary's Office depends on a master membership file to maintain contact with individual members. This file is referred to countless times every day as a source of information important to the Society and to the members involved. All other Society records are kept up to date by incorporating in them changes made in the master file.

The master file also indicates the Professional Divisions in which members have expressed an interest. Many Divisions issue newsletters, notices of conferences or meetings, and other material. You may express an interest in the Divisions (no more than three) from which you wish to receive any such information which might be published.

Your membership card includes key letters, below the designation of your grade of membership and year of election, which indicate the Divisions in which you have expressed an interest. Consult the form on this page for the Divisions to which these letters pertain. If you should wish to change the Divisions you have previously indicated, please so notify the Secretary.

It is highly important to you and to the Society to be certain that our master file indicates your current mailing address, business or professional-affiliation address, and interests in up to three Professional Divisions.

Please complete the form, being sure to check whether you wish mail sent to your residence or office address, and mail it to ASME, 29 West 39th Street, New York 18, New York.

Please Print

ASME Master-File Information

Date

LAST NAME _____ FIRST NAME _____ MIDDLE NAME _____

POSITION TITLE _____ NATURE OF WORK DONE _____
e.g., Design Engineer, Supt. of Construction, Manager in Charge of Sales, etc.

NAME OF EMPLOYER (Give name in full) _____ Division, if any _____

*☐

EMPLOYER'S ADDRESS _____ City _____ Zone _____ State _____

ACTIVITY, PRODUCT, or SERVICE OF EMPLOYER, e.g., Turbine Mfrs., Management Consultants, Oil Refinery Contractors, Mfr's. Representative, etc.

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HOME ADDRESS _____ City _____ Zone _____ State _____

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PRIOR HOME ADDRESS _____ City _____ Zone _____ State _____

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- ☐ MECHANICAL ENGINEERING — 10th of preceding month
- ☐ *Journal of Engineering for Power*
- ☐ *Journal of Engineering for Industry*
- ☐ *Journal of Heat Transfer* — 20th of preceding month
- ☐ *Journal of Basic Engineering*
- ☐ *Journal of Applied Mechanics*
- ☐ *Applied Mechanics Reviews* — 1st of preceding month

Professional Divisions in which I am interested (no more than *three*) are marked X.

- ☐ A—Aviation
- ☐ B—Applied Mechanics
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- ☐ W—Wood Industries
- ☐ Y—Rubber and Plastics
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ENGINEERING SOCIETIES PERSONNEL SERVICE, INC
[Agency]

THESE items are listings of the Engineering Societies Personnel Service, Inc. This Service, which co-operates with the national societies of Civil, Electrical, Mechanical, and Mining, Metallurgical and Petroleum Engineers, is available to all engineers, members or nonmembers, and is run on a nonprofit basis.

If you are interested in any of these listings, and are not registered, you may apply by letter or résumé and mail to the office nearest your place of residence, with the understanding that should you secure a position as a result of these listings you will pay the regular employment fee. Upon receipt of your application a copy of our placement-fee agreement, which you agree to sign and return immediately, will be mailed to you by our office. In sending applications be sure to list the key and job number.

When making application for a position include eight cents in stamps for forwarding application.

NEW YORK	CHICAGO	SAN FRANCISCO
8 West 40 St.	29 East Madison St.	57 Post St.

Men Available[1]

New York Office

Professor of Mechanical Engineering, BME, MSME; registered; 20 years' diversified experience in design, development, research, and application of advanced technology plus part-time graduate teaching in university. Presently engineering executive. $10,500. Optional. Me-893.

Project Engineer, MSME; 17 years' diversified engineering, research and management experience, seeks suitable position with manufacturer of heat-transfer equipment. Prefers large metropolitan areas. Me-894.

Administrative Engineer, ME from R.P.I., 1933; 25 years' broad engineering experience in teaching, mining, processing, and administration. Past 12 years in charge New York office of South American mining company where responsibilities included selection of machinery for purchase and export, administration of Eximbank loan for major plant enlargement, and co-ordination of R&D for improved refining processes. PE in New York State. Fair Spanish. Open. Prefers N. Y. Metropolitan area. Me-895.

Chief Engineer, Assistant or Staff Function, MSME; 28 years' mechanical engineering, with considerable electrical power experience and broad design, operating, and administrative experience in metalworking and manufacturing, desires position as chief, assistant, or staff function. $15,000. Prefers New England. Me-896.

Manufacturing Manager, BSME, MBA; 39; ten years' experience in engineering and manufacturing in instrument and electronic industries. Experienced in planning, scheduling, co-ordinating, setting up procedures, and directing engineering, production personnel. Prefers West Coast. Me-897.

Mechanical Engineer, approximately 12 years of practical engineering experience in such fields as product development, industrial engineering, machine design, sales and field engineering. Minimum $8300. Will relocate; prefers East. Me-898.

Executive Position, Maintenance, Sales, Import-Export, Personnel; BME Georgia Tech; 31; one year liquid gas plant; two years Great Britain engineering trainee, compressors, gas and diesel engines, steam turbines, diesel-electric locomotives; 4½ years parts and service manager Cuban automobile and truck distributor; perfect English-Spanish. $7800. Location immaterial. Me-899.

Product Manager, BSME, registered PE Ill.; assistant vice-president R&D, director R&D Div., project engineer: Domestic furnaces, hoists, auto hardware, vending-machine components, electric vehicles. Has established R&D prices. Worked with sales, production, service, and customer. $13,000. Open, but prefers Calif. Me-900.

Senior Supervising Project Engineer, BSME; 8 years' experience as supervising project engineer and project manager for engineering division of large chemical company; 15 years in engineering specialties manufacturing. $13,000 minimum. New York area. Me-901.

Sales Engineer, European degree comparable to BSME; nine years' U. S. experience in design of small electromechanical devices and export sales of heavy power-generating equipment. Fluent French, German, Dutch. Registered PE, N. J. $11,000. New York City or western Europe. Me-902.

Project Manager, BS in EE and ChE, PE; 15 years' experience with power plants as project engineer followed by ten years with consulting engineer in design and construction of iron and steel plants in U. S. A. and abroad. Prepared feasibility reports, market surveys, engineering studies, economic analyses. Thorough background in administration, sales, proposal, and engineering functions of engineering organizations. About $15,000. Open. Me-903.

Manager of Training and Development, BSME; five years' experience in heavy industry in field service and production; five years' industrial training of technicians, engineers, supervisors, and hourly production personnel. $9000. Open. Me-904.

Executive Engineer, BChE; 15 years' successful experience in engineering, general management, and planning effective use of all resources to reach corporate objectives. Experienced in recruiting, supervising, and rating professional personnel and in developing managers. Continental U. S. Me-905.

Engineer, considerable teaching and industrial experience desires position as professor of structural engineering and applied mechanics. Interested in teaching, research, and administrative work. Has doctorate in civil engineering; holds PE license for New York State. Available Feb. 1, 1961. Me-906.

Chicago Office

Chief, Project, or Application Engineer, BSME; 46; 20 years' experience; six years chief engineer, experience in design, product development, ferrous metallurgy, manufacturing, building construction, quality and cost control, customer applications in forging, heavy machinery, and railroad trackwork fields, excellent record, four patents. Open. Immaterial. Me-2046-Chicago.

Sales Engineer, BSME; 41; experience in sales mechanical equipment and antifriction bearings; installation of equipment in customers' plants; production of internal-combustion engines; work in foundries, machine shops, inspection, assembly, and testing. $8000. Midwest. Me-2047-Chicago.

Chief Engineer, BSME, BS Bus. Adm.; 36; experience in heavy, industrial engineered equipment, power-plant machinery; design, research, and development, manufacturing, general management, administration. $15,000 plus. Me-2048-Chicago.

Industrial Management Engineer, BSME, PE; 44; 19 years' experience management, sales, estimating, engineering, customer relations, negotiating and subletting contracts, and the supervision of erection of high-pressure steam boilers and their related equipment. Participating in labor relations and contract negotiations. Midwest. Me-2049-Chicago.

Chief Engineer, BSME; 36; responsible for utilities including 3 million gpd of water, 30,000 cfm of compressed air, 120,000 lb per hr of steam, 13 miles of primary electrical distribution. Also responsible for design and construction of a $3^1/_2$ million expansion during the past three yr. $13,000. Midwest preferred. Me-2050-Chicago.

Design Engineer, BSME; 25; four years' experience in oil refining. Experience in design, construction, estimating, and maintenance of process units; operations of high and low-pressure steam system. Open. East or Midwest. Me-2051-Chicago.

Design and Development Engineer, BSME; 38; ten years' experience in design and development of diesel engines. Senior project engineer, $10,000. Midwest or West. Me-2052-Chicago.

Mechanical Engineer, BME; 49; eight years experience in research and development on projects involving air, gas, dust, and their measurement; fabrication of light metals, welding, forming, machining, etc.; ten years' chemical-plant layout and equipment design: piping, pumps, reactors, materials-handling equipment and related equipment, also machine design; assistant plant superintendent, technical report writer. $10,000–$12,000. Prefers Midwest. Me-2053-Chicago.

Engineer, BSME; 34; four and half years' in product design. Electromechanical units, mechanisms, gears, cams, belts, castings. Packaging, heat, shock, and vibration problems. $745 month. Chicago, Ill. Me-2054-Chicago.

Positions Available

New York Office

Factory Superintendent, graduate, five to ten years' experience in factory management for company engaged in the manufacture of fans, blowers, etc. Must have considerable experience with sheet metal. About $12,000. Northern N. J. W-9928.

Plant Manager, mechanical or chemical-engineering graduate, to direct and co-ordinate the processing, plant engineering, and production in plastics manufacturing. Experience in plastics-processing machinery and in the economic evaluation. $12,000–$13,000. Eastern Pa. W-9927.

Boiler-Plant Maintenance Engineer, additional experience as industrial engineer, i.e., time study, methods, etc., for small plant manufacturing fabrics, felts, and coatings of plastics. $10,000–$12,000. Northern New England. W-9921.

Plant Industrial Engineer, graduate, five years' minimum experience in the manufacture of light electromechanical products. Will have several junior engineers reporting to him. About $9000. Northern N. J. W-9916.

Mechanical Engineers. (*a*) Design mechanical engineer, graduate, two to five years' experience in mechanical components, i.e., special duty valves, power cylinders, landing gears, and shafting. $7800–$10,000. (*b*) Design mechanical engineer, graduate, experienced in the design of oil-hydraulic-power-transmission systems and controls. $7800–$10,000. Conn. W-9909.

Manufacturing Manager, 35–45, to take complete charge of manufacturing, production planning and control, material controls, purchasing, manufacturing engineering, and plant maintenance. Must have had manufacturing experience with electronic instrument company doing government work. Must be able to meet production deadline and be able to work with union. $16,000–$18,000, plus fringe benefits. Relocation expenses paid. New York, N. Y. W-9906.

Mechanical Engineer, advanced degree desirable, at least ten years' experience in actual manufacturing or in consulting, preferably in the consumer-goods field, to direct the engineering activities of an industrial-design organization

Additional listings of positions and men available are maintained in the offices of E.S.P.S. Direct inquiries to nearest office. A weekly bulletin of engineering positions open is available at a subscription rate of $4.50 per quarter or $14 per annum, payable in advance.

[1] All men listed hold some form of ASME membership.

Will be concerned with the mechanical aspects of the creation of mock-ups and working models for clients, but not necessarily with their manufacture. Must be able to work harmoniously with design, marketing, and production executives. $15,000–$20,000. New York Metropolitan area. W-9903.

Mechanical Engineers for development work related to chemical processes for experimental projects and modifications. Ultra-high-pressure pilot plant. (*a*) Project engineer, three to eight years' experience. $10,000–$11,000. (*b*) Mechanical engineer, three to five years' experience planning experimental projects. $9000–$10,000. (*c*) Design engineer, mechanical or chemical, five to ten years' experience; high-pressure experience desirable. $9000–$10,000. Ill. W-9897-C.

Senior Industrial Engineer, 40–45, heavy experience in wage incentives, time study, methods, production planning, plant layout, materials handling, maintenance. Should have ability to sell services of manufacturing division. Will serve as back-up man to vice-president. Some travel. Headquarters, New York, N. Y. W-9892.

Chairman, Department of Mechanical Engineering, PhD or ScD, 40–52, at least three years' teaching mechanical engineering at approved school of engineering; at least three years' industrial experience with attainment of responsible charge of significant work; demonstrated ability to perform research and stimulate desire for research by others. $13,000, 11 months, plus 10 per cent. South W-9889

Engineers. (*a*) Sales engineer, recent graduate mechanical. After brief training period job will consist chiefly of liaison work between sales agents and plant-engineering department and management. Will involve both mechanical engineering and application of equipment to meet customers' requirements. Must be willing to relocate when opportunity offers. Conn. (*b*) Industrial engineer to take charge of methods and setting up standards on machine-tool operations. Must be thoroughly trained in rate-setting methods and be familiar with operation of general purpose machine tools such as engine lathes, turret lathes, milling machines, etc. Conn. W-9884.

Chief Engineer for a textile-machinery manufacturer, graduate mechanical preferred, experience in machinery design; experience in textile field. Should have organizational and planning ability; ability to handle customers and complaints; policy-making ability corporation-wise and engineering-wise. Salary plus bonus based on profits. Present location, New England; but must be willing to relocate in South. W-9883.

Production Manager, graduate mechanical preferred, at least five years' experience in the supervision of production in metals formation including hot and cold-rolled steel, stainless, and aluminum. Must know curtain-wall problems or closely related activity. Will be responsible for all field and shop fabrication and erection for curtain wall and window-wall installations. $12,000–$15,000, including bonus. Ohio. W-9882.

Partner, 40–50, for a long-established consulting-engineering firm. Must have heavy experience on the HVAC field on the design work for industrial and public buildings, schools, churches, etc. Should have experience and skill in the promotion of new business. Open. 100 miles out of New York City. W-9876.

Engineers. (*a*) Welding engineers, degree in welding engineering or equivalent, five to 15 years' experience. Experience with the welding of stainless steel (austenitic series), inconel, monel, and carbon steels. Will be responsible for preperation of welding procedures and interpretation of specifications, reports, etc. To $12,000. (*b*) Mechanism engineers, graduate mechanical, three or more years' experience. Knowledge of design principles and fabrication experience with actuating mechanisms for control of nuclear core activity. Design and fabrication experience in related items such as servomechanisms, mechanical linkage, and actuating systems, etc. To $10,800. (*c*) Pump-component engineers, graduate mechanical or electrical, three or more years' experience with either large centrifugal or positive displacement pumps. Experience applicable to canned rotor and canned station type pump desirable. Knowledge of principles of design, materials selection, and fabrication method necessary. To $10,800. Company pays fees and relocation expenses. Pa. W-9875.

Engineers. (*a*) Manufacturing engineer, graduate mechanical or industrial, 28–40, four to eight years' experience in determining machining methods. Duties will include the determination of machining and manufacturing sequences from prints and practices for a variety of small, close-tolerance parts. Will specify methods, tooling, and machines to be used; write operation sheets. $7800–$8500, plus profit-sharing. (*b*) Cost estimator, engineering training desirable, 30–50, knowledge of castings, forgings, make or buy decisions related to small electromechanical devices. Will estimate manufacturing costs from prints and specifications for wide variety of small, intricate, close-tolerance fabricated parts. Job-shop-type operation. $7000–$8500, plus profit-sharing. Company pays fees, relocation, and interviewing expenses. Include in application present and expected salary. Upstate N. Y. W-9861.

Mechanical Engineer, graduate, 30–40, familiar with rolling mills and auxiliary equipment. Must have experience with plant maintenance and ability to direct draftsmen in machine design for independent aluminum production mill. Apply by letter including experience, references, salary requirement. Mid South. W-9858.

Eastern Manager, mechanical-engineering graduate, at least ten years' management, estimating, and sales supervision in construction industry covering air-conditioning installations in commercial and industrial buildings. Open. W-9854.

Plant Engineer, at least eight years' experience in food or allied fields covering materials handling, processing, maintenance, equipment evaluation, reports, etc. $9000–10,000. Company pays fee. Md. W-9788.

Professor of Mechanical Engineering, to develop research and education programs in the design area. Open. Midwest. W-9776.

Sales Engineer, ME or AE, or heavy engineering background, with design, project, or systems experience. Knowledge of defense industries dealing in heavy machinery, mechanisms, missile ground-support equipment, etc., is essential. Should have contacts with Armed Services or weapon system prime contractors. $10,000–$12,000. Company pays fee. Headquarters, N. J. Territory, Southeastern U. S. W-9771.

Chicago Office

Engineers. (*b*) Project engineers and designers, reciprocating compressors, BSME or equivalent, five to ten years' experience with reciprocating compressors. Under general supervision, will plan, conduct, and supervise assignments. Estimate manpower needs and schedule work to meet completion dates and technical specifications. Co-ordinate and supervise activity of design engineers and draftsmen; maintain liaison with manufacturing and product departments; review progress and evaluate results; make changes in design. Will operate with appreciable latitude of action or decision. $8000–$10,000. (*c*) Senior application or proposals engineer, reciprocating compressors; mechanical or chemical engineer, five years' process-engineering experience in refining and/or chemical-process industries. Will perform liaison work between compressor product department, field sales, engineering, and manufacturing departments. Analyze and prepare technical data covering special applications on compressor products and associated service items, such as power equipment, compressor systems, piping, controls, etc. Analyze inquiries for special machines to determine whether they can be built and sold at a profit. Develop need for new and variable designs; responsible for technical and commercial marketing support. Prepare price data from analysis of costs, technical, and competitive pricing information. Assist in review and preparation of pricebook, sales manual, sales promotion, and instruction-manual material. Supervise training and development of application engineers. $9000–$12,000. Company pays fees. Northern Ind. C-8381.

Instructor, MS preferred, to teach courses in machine design starting September, 1961. Will have opportunity to teach courses at graduate and undergraduate level and to assist in development of a new PhD program which is sponsored by industry. Salary and rank will depend on education and experience. Ohio. C-8379.

Project Engineer, graduate mechanical, to 36; at least three years' experience in mechanical and hydraulic design of centrifugal pumps. Will co-ordinate the commercialization of design from marketing concept to manufacture. Some travel; no car required. Company manufactures pumping equipment. $8500–$12,500. Company will negotiate fee. Iowa. C-8374.

CANDIDATES FOR MEMBERSHIP AND TRANSFER IN ASME

THE application of each of the candidates listed below is to be voted on after Jan. 25, 1961, provided no objection thereto is made before that date and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the Secretary of The American Society of Mechanical Engineers immediately.

New Applications and Transfers

Alabama

●BAER, RUSSEL F., Decatur
BETHAY, JOSEPH A., Huntsville

Arizona

HERSEY, HOWARD F., Phoenix

Arkansas

BRADFORD, SAMUEL C., Pine Bluff

California

●ARCHER, WILLIAM E., Los Angeles
BERLIOZ, LOUIS M., San Francisco
BOEHLE, WILLIAM F., Van Nuys
BRINER, CLIFTON F., El Monte
●BURNS, HENRY, Hollywood
CHEN, KENNETH Y., Vernon
CRAIN, RICHARD W., JR., San Francisco
●DAOUSSIS, SPYROS, Pomona
GAEFCKE, ROGER L., Granada Hills
JENSEN, LLOYD E., Los Angeles
MALEK, GEORGE J., San Diego
PILLOW, JACK H., Belvedere-Tiburon
●ROE, ARNOLD, Los Angeles
ROLAND, CHARLES W., San Francisco
●SEIDE, PAUL, Palos Verdes Estates
●WHITE, GARLAND B., JR., La Habra

Colorado

CHU, HU-NAN, Littleton
GARRIS, JAMES E., Englewood

Connecticut

BASCOM, CLIFFORD W., Niantic
BERGQUIST, ROGER T., Bristol
CURRIE, JAMES A., New London
HALBERT, ERIC H., Hamden
PIRES, ANTONIO, JR., Norwalk
PURINTON, JOHN H., Middlebury
SCHILLER, FRANCIS, West Hartford
TOMASSETTI, NICHOLAS R., Meriden

Delaware

●STERGIS, BASIL G., Wilmington
TAYLOR, RICHARD W., Wilmington

District of Columbia

COMBE, MICHAEL A., Washington
●LUNCHICK, MYRON E., Washington

Florida

PUCCI, GERARD R., Coral Gables
SCHELLER, WILLIAM F., Warrington
SMALL, KEITH L., Panama City

Georgia

●DISHER, THOMAS L., JR., Atlanta

Illinois

BARNEWOLT, WALTER E., Peoria
BAYNE, JAMES W., Urbana
●BORUCKI, ROBERT B., Chicago

●Transfer to Member or Affiliate.

HAUG, EDWARD W., Rockford
●HEAP, JAMES C., Elmhurst
JACKLIN, CLARENCE, Downers Grove
●KELLY, PETER W., Rockford
MATZ, EARL H., Roselle
WALLACE, JOHN B., Western Springs

Indiana

LANDRUS, JAMES D., Plainfield

Iowa

BYERS, GERALD F., Cedar Rapids
DANSON, WALLACE R., Cedar Rapids

Kansas

GREENE, GEORGE O., Wichita
LEWIS, MARION F., Wichita

Kentucky

MULLIN, THOMAS E., Louisville

Maryland

●MERCANTI, ENRICO P., Hyattsville
●NEELY, JAMES V., Silver Spring
STAUP, CLYDE G. R., Linthicum Heights

Massachusetts

CARNEY, LORING W., Boston
EXTER, ALLEN D., Brookline
HICCOX, ALFRED W., Attleboro
LEAHY, JOHN F., Stoughton
WEINER, DAVID K., Springfield

Michigan

HAWRAN, HENRYK, Kalamazoo
SELIGSON, WALTER R., Detroit

Minnesota

ALLEN, ALDEN W., St. Paul
PLICHTA, WILLIAM J., Hoyt Lakes

Nebraska

●LOWDER, LEONARD R., Omaha
●VERSAW, WILLIAM D., Lincoln

New Hampshire

BENNETT, THOMAS J., Dover

New Jersey

JAFFE, GERALD, Clifton
●RAHOCHIK, ANDREW, South Plainfield
RESEK, ROBERT B., Camden

New Mexico

BLACK, RICHARD E., Alamogordo

New York

ARBORE, LOUIS A., Queens Village
BUA, CARMINE J., Brooklyn
BINDER, RALPH H., Fairport
CONGDON, DONALD E., Albany
CRUMME, RALPH S., Hartsdale
●GRAF, HENRY R., Kenmore
GIBSON, JOHN R., New York
●GIESEY, JOHN M., Mohawk
●JOHNSON, HAROLD E., Olean
KENT, MELVIN L., Watertown
KIMM, RALPH, Middle Village
KULKA, PETER, Clyde
●LABRIE, THEODORE J., Oceanside, L. I.
LUDWIG, GEORGE A., Scotia
MATERNA, WILLIAM C., New York
SCHULER, THEODORE F., Beacon
SHOTWELL, JOHN S. G., Brooklyn
STONE, ROY, Woodside
VAUGHN, CHARLES E., Rochester
VERGAMINI, GEORGE E., Corning
WARNOCK, ERNEST J., Depew

North Carolina

BURLESON, CHARLES V., Raleigh
UTLEY, EDWIN E., Lumberton

North Dakota

●DOWELL, HAROLD L., JR., Grand Forks

Ohio

HEIMBERGER, WILLIAM W., Columbus
HUBER, FERDINAND V., Massillon
LOCK, ERIC V., Cleveland
LOTZ, WILLIAM A., Johnstown
MILDREN, WALTER A., Granville
SMITH, CLEMENT C., Akron
SWENSON, HOWARD S., Alliance
WESLING, ALBERT R., Sylvania

Oklahoma

●CRITZ, ROBERT G., Tulsa
SIMPSON, JACK M., Tulsa

Pennsylvania

BEECHER, DONALD T., Murrysville
BEER, WILLIAM B., Pittsburgh
BERTA, NORBERT, Philadelphia
COURSEN, JOHN W., Wilkes-Barre
CURRAN, RALPH G., Erie
●DODSON, ELLIOTT E., State College
●FERRISS, JOHN A., JR., Erie
MCCOLGAN, JOSEPH T., JR., Nescopeck
MOORE, WILLIAM E., Oxford
PALLADINO, JEROME L., Berwick
THOMAS, ARTHUR E., Erie
TOTH, THOMAS, Allentown
●VACCARO, RAY ROBERT, Kittanning
●WECKERLE, JOHN H., Shillington
WOLF, DONALD R., Johnstown
●YARNALL, D. ROBERT, JR., Philadelphia

Rhode Island

CHABOT, LEO V., Cranston
●MONGEAU, ROLAND E., Manville

Tennessee

COX, WILLIAM J., Kingsport
MOSER, HUGH E., Kingsport

Texas

BURDA, JOHN J., Houston
DAIGLE, JOSEPH D., Houston
HOFFMAN, CLARENCE W., Borger
LANGE, KENNETH W., Houston
TOLBERT, WILLIAM C., Beaumont

Virginia

HALLIDAY, JOHN, Hampton
HORAN, FRANKLIN I., Newport News
SELLS, HAROLD R., Springfield

Washington

HARTZMAN, MARK, Seattle

West Virginia

MAZZONE, FRANK L., Sistersville
TAYLOR, STUART B., Parkersburg

Wisconsin

WILLIS, NEWTON H., Waukesha

Foreign

CASIPLE, RODOLFO M., Diliman, Rizal, The Philippines
●DIXON, ALEXANDER E., Kingston, Jamaica, West Indies
GEBHART, FRANK, Mexico D. F., Mexico
LABOSSIERE, GERALD R., Labrieville, Que., Can.
OGLANBY, WILLIAM D., Montreal, Que., Can.
●RAO, N. S. R. K. V., Karlsruhe, Baden, West Germany
SALVADOR, LEOPOLDO, Buenos Aires, Argentina
SIGAL, GEORGE P., Montreal, Que., Can.
WHEELER, MICHAEL T., Toronto, Ont., Can.

OBITUARIES

Charles Thomas Alverson, Jr. (1923–1960), project engineer, General Regulator Corp., New York, N. Y., died, Sept. 25, 1960. Born, New York City, May 24, 1923. Education, BME, The Cooper Union, 1944. Mr. Alverson joined the company in 1946 as a service engineer. He worked in the field of combustion control of power and industrial plants. Assoc. Mem. ASME, 1946. Surviving are his wife, Marjorie, and their five children.

George Arnold (1868–1960), retired engineer, died, March 29, 1960. Born, Cleveland, Ohio, April 16, 1868. Education, home schools. Mr. Arnold gained his practical experience in the drawing room of The Brush Electric Co., Cleveland, and as the designer of a small lighting station at Ellsworth, Me. He became the company's chief draftsman in 1892, a position he occupied until 1895, when he joined Adams Bagnall Electric Co., Cleveland, as an engineer. In the years that followed, he also was a superintendent of the Ft. Wayne Lamp Co., of Cleveland; a draftsman with E. H. Dyer and Co., Cleveland, on sugar machinery; and chief draftsman for Ford, Bacon and Davis of New York City, designing and constructing railroads and power plants. Before retiring, he was a design maintenance engineer with the Cleveland Frog and Crossing Co. Mem. ASME, 1904.

Joseph M. Barnes (1892–1960), retired drafting engineer, died, Sept. 26, 1960. Born, Philadelphia, Pa., July 12, 1892. Parents, Leonard Edward and Anna (Ludwig) Barnes. Education, attended Spring Garden Institute, Temple Univ., and The Franklin Institute. Married Mae M. Wellbank, 1919; children, Joseph M., Jr., and Marie T. Mr. Barnes was with Philadelphia Electric Co., as a specialist in generating-station design for 46 years at the time of his retirement last June. He joined the company in 1914 as a draftsman, and advanced to chief mechanical draftsman and then engineer in charge of the Drafting Division. He had previously spent eight years with the Baldwin Locomotive Works in Philadelphia. Assoc-Mem. ASME, 1921; Mem. ASME, 1928. He was chairman of the ASME Philadelphia Section, 1931–1932; and represented ASME on the ASA Committee Z-32, of which he was chairman. Member also, Edison Electric Institute; The Engineers' Club of Philadelphia, of which he was past-president; Electrical Association of Philadelphia, National District Heating Association; and Technical Drawing Associates. Surviving are his wife; son, Joseph; daughter, Mrs. P. K. Sen of India; and a brother, Thomas B. Barnes.

Sydney Bevin (1885–1960), former chief engineer with Fiske Brothers Refining Co., Toledo, Ohio, died, May 29, 1960. Born, New York, N. Y., Nov. 2, 1885. Parents, Leander Augustus and Laura (DeLamater) Bevin. Education, ME, Cornell Univ., 1908. Married Elsie Anne Smith, 1934; one daughter, Virginia. Mr. Bevin worked primarily with machinery and plants in the fuel industry, particularly with the Fiske Brothers Refining Co., for whom he built a grease and oil-making plant in Toledo, Ohio, in 1915. He also was secretary of the company, and a member of the board of directors for a period. He began his career in 1908 with the Rider-Ericsson Engine Co. of Walden, N. Y., where he had charge of half of their foundry for a year, supervising machine design. With the Matheson Automobile Co., Wilkes Barre, Pa., several years later, he worked on the design of motorcar parts, and was associated with several other machine and tool companies before going with Fiske Brothers. He spent many years with the company, with the exception of a year with the U. S. Army as Captain of the Ordnance Department, Washington, D. C. He also worked with the Tide Water Oil Co., New York, N. Y., establishing a physical research laboratory for the study of fuels, oils, and greases in internal-combustion engines. Assoc. Mem ASME, 1909; Mem. ASME, 1921. Member also, SAE.

Frederick Nathan Bolles (1883–1960), partner, Jaros, Baum and Bolles, New York, N. Y., died, August 24, 1960. Born, Newark N. J., May 24, 1883. Education, ME, Columbia Univ., 1907. A specialist in heating and ventilating, Mr. Bolles worked with several firms and the U. S. Navy before building his own consulting practice in New York City, beginning in 1923. He was a member of the firm of Young and Bolles in San Juan, Puerto Rico, from 1910 to 1912, doing design work on small power plants. Then he spent five years with New York Edison Co. in New York City, after which he became a member of the Civil Engineer Corps, U. S. Navy, with the rank of commander. During World War I, he had direct charge of the design and construction of steam-heating plants, and overhead and underground distribution systems at naval stations at Bumkin Island, Boston Harbor; Hingham Station and ammunition depot, Hingham, Mass.; Naval Air Stations at Chatham, Mass., Eastleigh, England, and St. Inglevert, France; and naval training stations at Detroit, Mich., and Coddington Point, Newport, R. I. In private consulting engineering practice from 1923 to 1932, he specialized in designing steam-generating plants and air-conditioning systems, and doing heating, ventilating, and sanitation work. In this capacity, he handled all the mechanical and electrical designs for the firm of Kenneth M. Murchison. In 1932, he became the third partner in the 30-year-old firm of Jaros and Baum, making the firm name Jaros, Baum and Bolles. Mem. ASME, 1946. He was a licensed professional engineer in seven states, New York, Delaware, Connecticut, Michigan, New Jersey, Pennsylvania, and Ohio.

Neal W. Dorman (1885–1960?), retired engineer, died recently according to a notice received by the Society. Born, Geneva, Ohio, July 25, 1885. Education, night school. A specialist in machine-tool design and standardization, Mr. Dorman served an apprenticeship in machine work from 1902 to 1904 with the Toledo Metal Furniture Co. He also worked with the Pope Motor Co., and the Willys-Overland Co., all in Toledo. Then he became a tool designer with Seager Engine Works, Lansing, Mich., in 1910, shortly thereafter going to work on layout and detail drafting with the Studebaker Corp. of Detroit. In 1912, he went with the Toledo Machine and Tool Co., as a designer of sheet-metalworking tools. He became assistant in charge of the engineering department, and of standards; and during World War I directed the design and construction of many large presses. He also taught shop mathematics for a period in the Toledo YMCA night school. Before retiring in Toledo, he worked with the E. W. Bliss Co. Assoc-Mem. ASME, 1913; Mem. ASME, 1922.

Arthur Edwards (1901–1960), mechanical engi-

neer, Stone and Webster Engineering Corp., Boston, Mass., died, April 28, 1960. Born, Chicago, Ill., May 13, 1901. Parents, Arthur R. and Susannah H. Edwards. Education, BS(ME), M.I.T., 1923. Mr. Edwards was associated with Stone and Webster since 1925. He started as a draftsman and was soon promoted to engineer. Specializing in technical analysis, he worked on the design of steam-electric generating stations, and later was a field engineer on the construction of a steam-generating station for the General Electric Co., Buffalo, N. Y. Before joining Stone and Webster, he held positions with the Commonwealth Edison Co., Chicago, Ill., and General Electric Co. Later, he also was a product-testing engineer with Dewey and Almy Chemical Co., working on "multibestos" brake linings and clutch facings for automobiles. Assoc.Mem. ASME, 1940. He was a licensed professional engineer in New York State.

Sven Erik Gustav Eriksson (1901–1959), director in charge of production, Allmänna Svenska Elektriska Aktiebolaget, Västeras, Sweden, died near the end of 1959 according to a notice received by the Society. Born, Örebro, Sweden, Nov. 22, 1901. Education, EE degree, Royal Institute of Technology, Stockholm, 1924. Mr. Eriksson joined ASEA, manufacturers of electrical equipment, in 1924, entered the company's training course for graduate engineers, and by 1926 was an engineer in the company's laboratory for electrical machines. A year later, he was shop superintendent and assistant to the works manager at the company's Russian works in Jaroslaw, USSR; and in 1932 held the same position at the Ludvika Works, Ludvika, USSR. Advancing further, he was placed in charge of rationalization of ASEA Electric Ltd., Walthamstow, London, in 1934; and in 1937 became works manager at Ludvika, and manager in 1941. Six years later he was director in charge of production for the company. He authored several articles and papers on rationalization problems. Mem. ASME, 1948. Member also, Svenska Teknologforeningen (Swedish Association of Engineers).

Frederick Mather FitzGerald (1902–1960), director of research, Draper Corp., Hopedale, Mass., died, Boston, Mass., Oct. 4, 1960. Born, Milford, Mass., August 17, 1902. Education, high-school. Mr. FitzGerald was chairman of the ASME Textile Engineering Division. He was associated with the Draper Corp., textile-machinery manufacturers, since 1920, when he began a three-year apprenticeship as a draftsman. He was absent from the company for one year while working with the Stafford Co., Readville, Mass., but returned in 1925 to design and then supervise the design of machinery. In 1937, he was made superintendent of a new factory in Spartanburg, S. C. Two years later, he was superintendent of all foundry operations for Draper Corp., which were carried on in three separate foundries, two in Massachusetts and one in South Carolina. He worked with the specification, purchase, and installation of complete mechanical-mold and sand-handling equipment. He became director of research and of corporation in 1947. Mem. ASME, 1958. Member also, Society for Experimental Stress Analysis, and president of the N. E. Foundrymens Society.

Donald F. Fraser (1913–1960), vice-president of manufacturing, Garlock Inc., Palmyra, N. Y., died, Chesapeake and Ohio Hospital, Clifton Forge, Va., Sept. 12, 1960. Born, Toronto, Ont., Canada, March 28, 1913. Education, BA in Science, Univ. of Toronto, 1934. Mr. Frazer, a design specialist in rubber and plastics, joined Garlock Inc. in 1954, and was acting chief engineer, successively becoming works manager, production manager, and in 1957, vice-president of manufacturing. He supervised all production facilities at Palmyra and five subsidiary plants. Before his association with the Palmyra firm, he was vice-president and general manager of Rodic Chemical and Rubber Corp., New Brunswick, N. J. He entered the field of rubber and plastics in 1934 as a technical manager of the Latex foam sponge department of Dunlop Tire and Rubber Goods Co., Ltd., Toronto. He was with them for three years, after which he joined the Rubber Chemicals Division of E. I. du Pont de Nemours and Co., Inc., Wilmington, Del. From a position as a demonstrator in the rubber laboratory, he worked with automotive and aeronautical engineers to develop uses for the synthetic rubber, neoprene. As an administrative assistant with the Rubber Reserve Comm., RFC, Washington, D. C., during the war, he had charge of the technical development of a government neoprene plant. In 1944 he became manager of the rubber and plastics division of Monroe Auto Equipment Co., Monroe, Mich., designing and developing injection molding equipment for rubber. He also was general manager of the Queen City Tulatex Corp., Burlington, Vt. He authored a number of articles on the economics and properties of neoprene, some of which were published in *Industrial and Engineering Chemistry*, and *Rubber Chemistry and Technology*. Mem. ASME, 1954. He was a director of the New York Rubber Group, and a member of the American Chemical Society.

Gottlieb John Gruber (1885–1960), retired designing engineer, died, July 6, 1960. Born, Maennedorf, Zurich, Switzerland, May 5, 1885. Parents, David Johannes and Anna (Hardmeyer) Gruber. Education, ME, Ecole Polytechnique, Zurich, 1909. Naturalized U. S. citizen, Centreville, St. Joseph City, Mich., 1926. Married Emmy Vollenweider, 1929; one daughter, Ruth Elizabeth. A designer of centrifugal pumps and steam turbines, Mr. Gruber held positions with companies in Switzerland, France, the U. S., and Canada. Before coming to the U. S., he worked with the Escher Wyss Co., Zurich, on steam turbines; the Société de Moteurs à Gaz et d'Industrie Mécanique, in Paris, designing and testing centrifugal pumps and complete water works; and the Société Rateau, Paris. During World War I, he was sent on a technical mission to Cherbourg and Brest, where he supervised the erection and tests of large vertical electric-driven dry-dock centrifugal pumps. Emigrating to New York City, he held successive positions with Roland and Burns, and Perin and Marshall, both consulting engineering firms, for whom he worked on the design of steam and water-power plants, and pumping stations. He worked with Fairbanks Morse Co., Chicago, Ill., for seven years, having charge of company works in Wisconsin and Michigan. Thereafter, he was successively with Babcock & Wilcox, and Goldie McCulloch Ltd., Galt, Ont., Canada; Yeomans Brothers Co., Chicago, Ill.; Lawrence Machine and Pump Co., Lawrence, Mass.; and the Morris Machine Works, Baldwinsville, N. Y., where he was chief design engineer. Mem. ASME, 1924. Member also, Gesellschaft ehemaliger Polytechniker (GEP), Zurich; the Association d'Anciens Elèves de l'Ecole Polytechnique Federale de Zurich, and the Technology Club of Syracuse, N. Y.

William Raymond Hartline (1897–1960?), chief mechanical engineer, Ferguson and Ferguson, Los Angeles, Calif., died recently according to a notice received by the Society. Born, Gordon, Pa., Dec. 7, 1897. Education, attended Rankin Technical School, St. Louis, Mo. A specialist in heating and ventilating systems, Mr. Hartline held positions in many states and Washington, D. C., during his career. In the past ten years, he held important posts with several companies. He was a project and senior mechanical engineer, 1949–1953, with Lescher and Mahoney, Phoenix, Ariz., working on steam plants and air-conditioning systems for schools, libraries, and churches. Then he was assistant chief and later chief mechanical engineer with the consulting engineering firm of Headman, Ferguson and Carvalla, in Phoenix, and Berkeley, Calif., where he did similar work on office buildings and several Alaskan Air Force bases. In 1955, he was a design engineer with Welton Becket and Associates, Los Angeles; and in 1955 was assistant chief mechanical engineer with Albert C. Martin and Associates, Los Angeles. There he did heating and ventilating work on commercial, industrial, and institutional, projects. During the 30 years previous to 1949, he worked on numerous projects, including two years spent with the U. S. Army Air Service; five years as a draftsman with The Texas Co., Houston, and New York; and a period as an engineer and partner with District Machine Works, Washington, D. C. He also was vice-president and treasurer of Combustioneer Corp., contractors and engineers of Washington, D. C.; a sales engineer with Engineering Service and Supply Inc., San Francisco, Calif.; a design engineer with Hawaiian-Raymond-Turner, Pacific Naval Air Base contractors in Honolulu; as well as holding several other positions with companies in California and Arizona. During World War II, he was a chief shipfitter in the U. S. Navy. Member also, ASHRAE and Engineers and Architects Institute. He was a registered professional engineer in the states of California, Arizona, and New Mexico.

Kilshaw McHenry Irwin (1893–1960), vice-president in charge of engineering, Philadelphia Electric Co., Philadelphia, Pa., died, Jefferson Hospital, Philadelphia, Oct. 3, 1960. Born, Waukesha, Wis., Sept. 19, 1893. Parents, Franklin Kilshaw and Mary (McHenry) Irwin. Education, PhB, Sheffield Scientific School, Yale Univ., 1915. Married Katherine Edgar, 1919; children, Margaret Edgar and Thomas Kilshaw 2nd. Mr. Irwin was Vice-President of ASME, 1939–1942. A specialist in power-plant design and construction, he was a pioneer in the development of inter-company contracts for electric power and steam. One of the earliest of these contracts involved the Deepwater Station agreements between several power companies and a large industrial company, incorporating plant ownership, operation, and interchange of power. He also aided in the restoration of utility services in Northwest Europe as executive director of the London staff, Public Utilities Committee of the Combined Production and Resources Board, which he served in 1944. Mr. Irwin devoted a major portion of his career to the service of the Philadelphia Electric Co., where he began as an assistant to the vice-president in charge of engineering in 1931. In that position, he was directly responsible for the mechanical design of Barbadoes Island power station, Philadelphia Electric Co., Devon power station, Connecticut Light and Power Co.; Big Sioux power station, Sioux City Gas and Electric Co.; and Deepwater power station, Deepwater Light and Power Co. Then, and later as manager of engineering for the company, he played an important part in the design of Southwark Station and additions to Schuylkill, Chester, and Barbadoes Stations. As vice-president in charge of engineering, he was responsible for the design and construction of Cromby Station, and an addition to Delaware Station, as well as a supercritical pressure project at Eddystone. An active participant on behalf of his company in the development of nuclear power for central stations, he was a vice-president and director of Atomic Power Development Associates, Inc., a group now engaged in research and development of a fast neutron power breeder reactor of 100-mw capacity. Mr. Irwin started his engineering career as a test engineer with B. F. Sturtevant Co. at Hyde Park, Mass., in 1915. In 1916 and 1917, he was a member of the Station Betterment Division, Stone and Webster Engineering Corp., Boston, Mass. His practice in 1918 as a consulting fuel engineer, in Boston, was interrupted by the World War and his enlistment as chief machinist's mate in the U. S. Navy. From 1919 to 1931, he held the position of mechanical engineer with the United Gas Improvement Co. He was a frequent contributor to engineering literature, including *Electrical World*, *Combustion*, *Current News*, and *Power Plant Engineering*, and delivered many papers and lectures to engineering and civic organizations. He was named Philadelphia "Engineer of the Year" in 1958. Junior ASME, 1917; Mem. ASME, 1930; Fellow ASME, 1947. He served ASME as chairman of the Fuels Division, 1934–1936; member of the Regular Nominating Committee, 1934; chairman of the Finance Committee, 1937–1939; and chairman of the Philadelphia Section, 1930–1931. Besides representing the Society, he also was chairman of the Committee to Co-operate with Consumer's Council with relation to activities of National Bituminous Coal Commission. Other engineering activities included membership in AIEE, NELA, AEIC, EEI, Tau Beta Pi, United States Committees on Steam Turbines and Diesel Engines, International Electrotechnical Commission Conference in Holland and Belgium, 1935; presidency of the Philadelphia Engineers' Club, 1936–1937; and vice-presidency of the Yale Engineering Association. He also was a member of the research and museum committees of The Franklin Institute; a member of the Newcomen Society; president of the Technical Service Committee, 1936–1937; member of the advisory council of the department of mechanical engineering, Princeton University, 1956; and member (1953), vice-chairman (1956), and chairman (1958), of the U. S. National Committee, World Power Conference. He was a member of the advisory committee in 1952 of the National Exposition of Power and Mechanical Engineering. Surviving are his wife, Katherine; daughter, Mrs. Margaret Gilman of Hoosick Falls, N. Y.; and son, Thomas, of Pitman, N. J.

Masawo Kamo (1876–1960), professor-emeritus, Tokyo Imperial Univ., and dean of engineering, Hosei Univ., Japan, died, August 29, 1960. Born, Tokyo, Aug. 15, 1876. Education, ME, Tokyo Imperial Univ. and Engineering College; DE. Dr. Kamo was on the faculty of Tokyo Imperial Univ. since 1898, and head of its department of mechanical engineering since 1912. He was one of Japan's most outstanding representatives in international engineering affairs and was chairman of the organizing committee for the 1930 World Engineering Congress held in Tokyo. He was elected an Honorary Member of ASME in 1929. Dr. Kamo designed the machinery departments for the first turbine steamers in Japanese waters. He authored the book, "Stationary Steam-Engine Design." As director of the Fuel and Ore-Dressing Institute, he was responsible for the research that determined the most efficient utilization of available coals and the proper methods of dressing gold ore in the Korean peninsula. He started his career as an assistant professor of marine engineering at Tokyo Imperial Univ. at the turn of the century, but left Japan in the early 1900's to study thermodynamics and applied mechanics in England and Scotland, followed by a three-year period in the United States, where he studied steam turbines and refrigerating machinery at General Electric Co. and Westinghouse Machine Co., among others. Returning to his university, he became professor of mechanical engineering, and occupied the chair of thermodynamics and steam turbines. In 1924, he was named director of the Fuel and Ore-Dressing Institute for the Korean peninsula. Mem. ASME, 1925; Hon. Mem. ASME, 1929. Member also, of the Engineering Standards Committee of the Japanese Government; the Institution of Naval Architects, London; Institute of Engineers and Shipbuilders, Scotland. He was past-president of the Japan Society of Mechanical Engineers, and of the Japan Association of Heating and Refrigeration.

Anthony Kennedy, Jr. (1902–1960?), assistant plant manager, Gray Mfg. Co., Hartford, Conn., died recently, according to a notice received by the Society. Born, Camden, N. J., March 18, 1902. Education, attended U. S. Naval Academy, Annapolis; MSc, Columbia Univ., 1930. Mr. Kennedy spent two six-year periods in the U. S. Navy, beginning as an ensign in 1923 on the *USS Pittsburgh*, where he had junior operating and maintenance responsibilities, and rising to the rank of Commander before leaving the service in 1946. From a junior engineer in 1923, he advanced to an engineer officer on the *USS Sands*, the *USS Dallas*, and the *USS Wright*,

with responsibility for administrating and training an engineering department. After attending a postgraduate course at Annapolis, he earned an EE degree at Columbia Univ., and joined E. I. du Pont de Nemours and Co., Inc., Philadelphia, Pa., as an assistant foreman in the power department. While there, he was responsible for a modernization program, involving standards, power distribution, and cost development and analysis. He developed apparatus for determining and maintaining fuel-oil temperature and pressures. He returned to the service in 1940 as a senior machinery planning officer at the Philadelphia Naval Yard, where he was in charge of planning and estimating all engineering installations, repairs, overhauls, and new construction. Then he was an engineer officer on the *USS Wisconsin*, overseeing an engineering department of 549 man and 18 officers. After the war, he went back to the Du Pont Co. where he was a project engineer in the construction department. He left the company several months later to take a position as assistant plant manager with Gray Mfg. Co., Hartford, makers of telephone paystations, electronic-dictation devices, and other electrical equipment. He soon became production manager. Mem. ASME, 1948. Member also, American Society of Naval Engineers. He was licensed as a chief marine engineer with the Department of Commerce; and a chief stationary engineer with the City of Philadelphia.

Henry C. Lehn (1881–1960), retired consulting engineer, died, Oct. 9, 1960. Born, Williamsville, N. Y., Nov. 23, 1881. Parents, John and Amelia Lehn. Education, high school. Married Harriet Dodge, 1911 (dec.), one daughter, Mary. A pioneer in the gas-pipeline industry, Mr. Lehn was responsible for the design and application of the horizontal gas engine compressors, developed for Worthington Corp., Buffalo, N. Y., where he was an engineer for 44 years. He was employed by the Snow Steam Pump Works of the International Steam Pump Co., Buffalo, in 1906, as a draftsman. He became assistant to the manager of the gas and oil department in 1911. Later, be became chief engineer and then consulting engineer for the company's engine division. He retired in 1950. Assoc-Mem. ASME, 1915; Mem. ASME, 1935. He was a registered professional engineer in New York State since 1923.

Sumner Marshall Manley (1878–1959), retired consulting engineer, died, October, 1959. Born, Brockton, Mass., July 6, 1878. Parents, Charles Galen and Alice (Marshall) Manley. Education, BS, M.I.T., 1900. Married Susanna R. W. Talbot, 1905; children, Robert Talbot and John Talbot. Mr. Manley was chief engineer of The Procter and Gamble Co., at Ivorydale, Ohio, from 1933 till his retirement. The Ivorydale office maintained a consulting service for all the engineering activities of Proctor and Gamble and of the Buckeye Cotton Oil Co. His association with the company began in 1905, when he joined it as a master mechanic at Kansas City, Kan. He advanced seven years later to assistant chief engineer, and nine years later to chief engineer, at Cincinnati, Ohio. During that time, Mr. Manley assisted in such projects as the construction of an oil refinery in Kansas City, and the design of special machinery for manufacturing Crisco, and of buildings and equipment to manufacture soap, glycerine, and cottonseed oil. He had been with the company for 25 years when he left for England in 1930 to become chief engineer for Thomas Hedley and Co., Ltd., at Newcastle-on-Tyne. There he designed and constructed soap factories, returning three years later to Procter and Gamble. During the earliest period of his career, Mr. Manley taught machine design for one year at Kansas State College, Manhattan, Kan. Assoc-Mem. ASME, 1907; Mem. ASME, 1917. He was a member of The Institution of Mechanical Engineers, London, and of the Engineers' Club of Cincinnati. He was a registered professional engineer in the states of Ohio and New York since 1935.

Robert C. Moffitt (1895–1960), consulting engineer, died, Seattle, Wash., Sept. 21, 1960. Born, Wallace, Idaho, April 25, 1895. Parents, Edward Hazleton and Effie Jane (Colborn) Moffitt. Education, ME, Cornell Univ., 1921. A mechanical and mining engineer, Mr. Moffitt helped to develop metal mines in the northwestern United States and British Columbia. After receiving his degree at Cornell, he assisted with mine and mineral surveys in Idaho, then took postgraduate studies at the University of Washington School of Mines, in Seattle. He entered the engineering department of the Washington Water Power Co. at Spokane, Wash., in 1922 and was occupied for the next two years with the design of bridge structures and hydraulic equipment. In 1924 he was a member of the First World Power Conference in London, England. Working toward his major interest, the management of metal mines, he invested in mining activity, but found a new interest in experimenting with marine internal-combustion engines, and in 1927 became president and executive engineer of the Sunset Marine Engineering Corp., Seattle. He designed and constructed a small shipyard with dry docks and shops for the repair of small vessels. He sold this business in 1930, and for a period was secretary-treasurer and chief engineer for Fisher Engineering Corp. in charge of technical work relating to the design and construction of a successful, small injection diesel engine. In 1934, however, he became vice-president and engineer in charge of developing and operating a silver-lead mine near Invermere, British Columbia. Later he was president of the operation, known as Thunderbird Mines, Ltd., which developed mines through road and tunnel construction and the installation of power machinery. He also became president in 1939 of the Mines Engineering Corp., Wallace, Idaho, a company that helped develop the Silver Summit Mine at Wallace by sinking a three-compartment vertical shaft at an underground station. At the time of his death, Mr. Moffitt was a consulting engineer out of Breckenridge, Colo. He held several patents on diesel engines. Assoc-Mem. ASME, 1925; Mem. ASME, 1932. Member also, AIME, SAME, and past-vice-president of the Seattle Chapter, Society of American Military Engineers. He was a registered professional engineer in the State of Washington.

Frank Joseph Nowak (1908–1960), chief engineer, Leslie and Elliott Co., Paterson, N. J., died, Aug. 28, 1960. Born, New York, N. Y., Feb. 19, 1908. Education, vocational school. Mr. Nowak was chief engineer with Leslie and Elliott Co. for 16 years. He worked as a design engineer with heavy steel-plate fabrication, carbon and stainless-steel material, pressure vessels, and power boilers. He had previously been in charge of the engineering department, for eight years, at Frank Heaters, Inc., Paterson, N. J., working with heat exchangers and hot water-storage heaters, instantaneous heaters, and oil heaters. Mr. Nowak started his career with Ransome Concrete Machinery Co., Dunellen, N. J., doing drafting work on concrete mixers, hoisting equipment, steel towers, and chuting plants. He also spent nearly a decade with C. H. Leach Co., Elizabeth, N. J., designing oil-refining equipment. Assoc. Mem. ASME, 1955; Mem. ASME, 1956.

James Crisman Rhoads (1912–1960), manager, Railroad Locomotive Subsection, Locomotive Car Equipment Dept., General Electric Co., Erie, Pa., died aboard the liner, *SS Argentina*, Sept. 30, 1960. Born, New York, N. Y., July 17, 1912. Parents, James C. B. and Marion (Painter) Rhoads. Education, BSME, Lehigh Univ., 1933; MSME, M. I. T., 1934. Married Elinor Brinser, 1937; children, James, Robert, and Mary Ann. Mr. Rhoads joined General Electric in 1934, spent one year as a test engineer, and then took the company's advanced engineering course for three years, during which time he worked on special assignments in the refrigerator unit factory and the company's research laboratory at Schenectady, N. Y. Transferring to the Erie Works in July, 1937, he was assigned to the mechanical-design section of the motor-engineering division, where he had charge of all gear, fan, and air-flow system design. Four years later he became section engineer. He remained with the division until late 1945, when he transferred to the locomotive-engineering division as assistant to the division engineer. In 1946, Mr. Rhoads received a joint Charles A. Coffin Award, the highest recognition the company can give, for his work on heavy and medium tanks during the war. He held several patents, and was coauthor of a paper on the "Design and Application of Rail Transportation Gearing," which appeared in the ASME *Journal of Applied Mechanics* in 1946. Mem. ASME, 1946. He was chairman of the ASME Erie Section, 1949–1950; and chairman of the Sections Committee, Region V, 1951–1952. He was a member of Tau Beta Pi and the American Gear Manufacturing Association, and a registered professional engineer in Pennsylvania. Surviving are his wife, Elinor; two sons and one daughter; a brother, William P. Rhoads; and a sister, Mrs. John G. Laferty.

Cyril Oliver Rhys (1882–1960?), retired mechanical engineer, died recently, according to a notice received by the Society. Born, London, England, Jan. 20, 1882. Parents, William Oliver and Jane (Jacobs) Rhys. Education, Camdem Road Collegiate School, London. Naturalized U. S. citizen, Elizabeth, N. J., 1927. Married Louise Ferrier, 1913 (dec.). Mr. Rhys contributed greatly to the application of mathematics to engineering and physical problems. He came to the United States in 1910, and for three years was in the maintenance department of the William Cramp and Sons Ship and Engine Building Company. During 1913 he did engine and boiler-testing work for the Bowers Southern Dredging Co. at Galveston, Texas. He then became a designer of industrial machinery for the Diamond Match Co. at Barberton, Ohio, and remained with them until 1918. Shortly after this Mr. Rhys became associated with the United Shoe Machinery Co. at Beverly, Mass., working in the experimental department. For a time he acted as an instructor at the Georgia School of Technology, Atlanta, teaching applied mechanics, geometry, and kinematics. From 1924 to 1931 he was in charge of a machine shop making laboratory equipment and experimental devices at Standard Oil Development Co., Elizabeth, N. J. He remained with the company till his retirement in 1947, spending a decade on the development of formulas for the design and retirement of tubes at elevated temperatures subjected to pressure, heat transfer, and corrosion. He reported his work during that period in the paper "Cracking Coil Tubes at War," which he wrote to supply the general need for predicting tube life when temperatures were raised to get maximum gasoline production during the war. He authored several papers and held patents on stress analysis and dynamic problems. Mem. ASME, 1946. He worked on the Pressure Vessel Research Committee. He was a member of the American Ordnance Association.

Christian Schillinger (1876–1959), president, Coxe Stoker Engineering Co., Hazleton, Pa., died, Nov. 12, 1959. Born, Gutach, Germany, Dec. 10, 1876. Education, attended Poly technical School, Villinger, Germany. A specialist in boiler and power plant work, Mr. Schillinger joined Coxe Stoker Co. in 1920. He was then already equipped with broad experience in the field, having gained it with the Delaware, Lackawanna and Western Railroad Co., Scranton, Pa. He worked with the railroad for about 20 years, beginning as an erecting engineer. From 1901 to 1908, he had charge of operating one of the company's largest boiler and power plants, and in the years directly following had charge of the construction and operation of all boiler and power plants. During this time, he designed and constructed the company's Hoboken, N. J., Long Slip boiler plant, Truesdale boiler plant, Loomis boiler plant, and many others. He originated the design of a method of handling ash by means of flushing systems and also devised a method for burning anthracite coal below the commercial size. He started at Coxe Stoker as a sales engineer, and at the same time consulted on the rebuilding of old plants and the designing of new ones. In this capacity, he helped design such plants as the Dalton Power Plant of the Scranton, Montrose, and Binghamton Railroad Co., Dalton, Pa.; the Port Carbon, Pa., plant of the Schuylkill Valley Coal Co.; and the Mahoney Plane plant of the Philadelphia and Reading Railway Co., near Frackville, Pa., among others. Mem. ASME, 1922. Member also, Engineers Society of Northeastern Pennsylvania.

Lester N. Shannon (1893–1960), senior vice-president, Stockham Valves and Fittings, Inc., Birmingham, Ala., died, Sept. 28, 1960. Born, Carbon Hill, Ala., July 9, 1893. Parents, Joe S. and Alice S. Shannon. Education, attended Birmingham Southern. Married Kate Little, 1917; children, Lester N., William H., and Jack H. Mr. Shannon was a specialist in foundry engineering, labor-saving equipment, and organization. As vice-president of Stockham Valves and Fittings, Inc., he organized company personnel and developed equipment layouts for more efficient materials handling. He served the company in various positions for 48 years, starting in 1912 as an inspector. He advanced through the posts of tapping-room foreman, labor foreman in the foundry, mechanical superintendent, 1918–1920; manufacturing superintendent, 1920–1924; factory manager, and then vice-president in 1925. Throughout his career, he had charge of organizing men and machines, and helped develop engineering policies. He received the French Medal of Honor for work with the International Committee of Foundry Technical Associations in 1953. Assoc-Mem., ASME, 1927; Mem. ASME, 1935. He was a member of ASTM, the Manufacturers Standardization Society of the Value and Fitting Industry, the American Management Association, and the National Metal Trade Association. He was past-president of the American Foundrymens Society.

James Edwin Tierney (1883–1960), engineer Lockheed Aircraft Corp., Burbank, Calif., died April 23, 1960. Born, Burlington, Iowa, Jan. 12, 1883. Parents, Martin S. and Mary (Goff) Tierney. Education, attended St. Mary's College, Albuquerque, N. Mex. Married Ida M. Schwed, 1905; one son, Stanley. Mr. Tierney specialized in fuel-oil burning facilities for railroad locomotives and industrial stationary boilers. His early career was with several railroads, including Southern Pacific, as a machinist; Kansas City Southern Railroad, Pittsburg, Kan., and Shreveport, La., as a general foreman; and the Louisiana and Arkansas Railroad, Stamps, Ark., as a mechanical superintendent. In 1930 he became president and general manager of Allube Corp., manufacturers of petroleum products, and in 1938 was lubrication engineer with Globe Grease Mfg. Co. Later, he joined A. J. Lynch and Co., producers of grinding and drawing oils, Los Angeles, Calif; and then Lockheed Aircraft Corp. Mem. ASME, 1922.

Charles Joseph Uthoff, Jr. (1917–1960), sales engineer, Southern Engine and Pump Co., Metairie, La., died, August 29, 1960. Born, New Orleans, July 22, 1917. Parents, Charles J. and Laura Marie (Tollefsen) Uthoff. Education, BS(ME), Tulane Univ., 1949; MS(ME), Louisiana State Univ., 1950. Married Patricia Hay; children, Dorian and Kimberly. Mr. Uthoff was a salesman with the Dixie Mill Supply Co., Inc., New Orleans, before joining the Southern Engine and Pump Co. Assoc. Mem. ASME, 1950. He is survived by his mother; his wife, Patricia, and their children; and a sister, Mrs. Francis M. Hogle, Jr., Daytona Beach, Fla.

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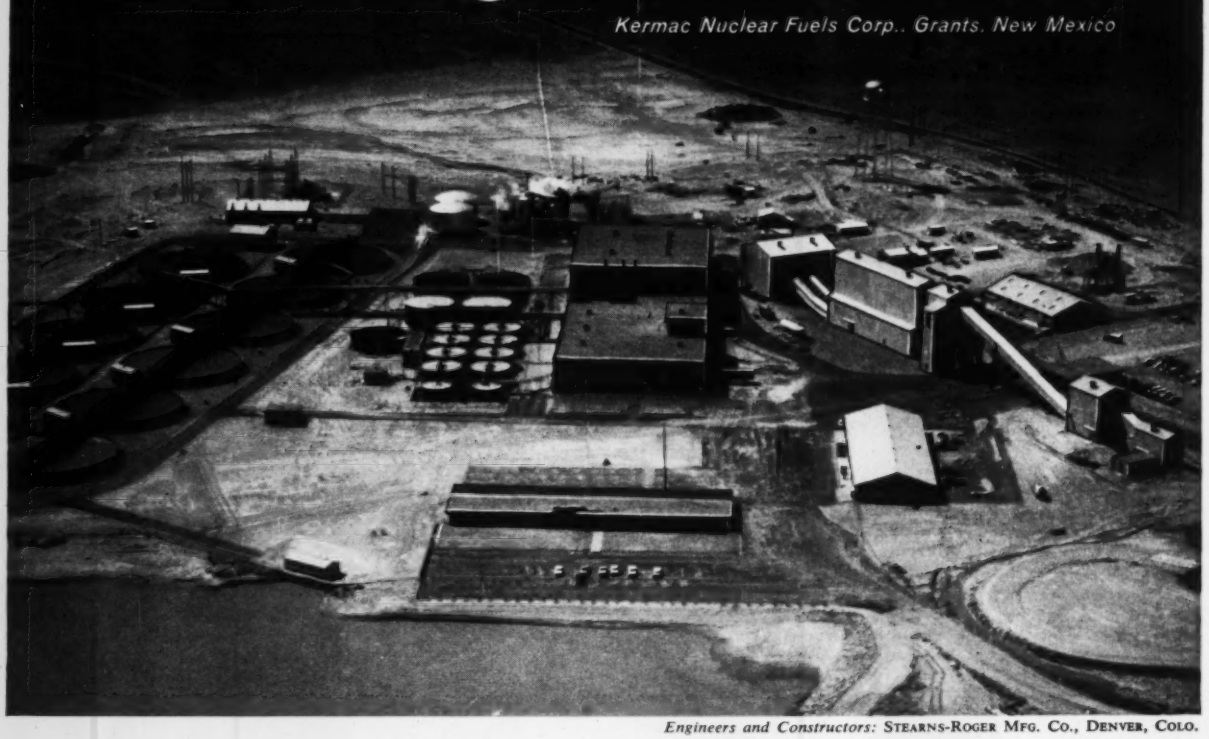

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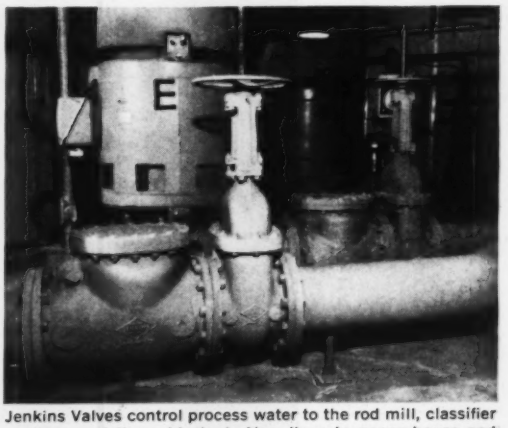
Here, uninterrupted functioning of valves is vital to continuous operation ...so JENKINS VALVES were chosen

This $18,000,000 mill, built in 1958, produces uranium oxide, called yellowcake, from raw uranium ore. Four to five pounds of yellowcake are obtained from a ton of ore by an acid leach, solvent extraction process perfected by Kerr-McGee Oil Industries, Inc. The product is sold under contract to the Atomic Energy Commission.

In the processing, ore and its many derivative components are put through so many washing operations that the mill might be termed the world's biggest "laundry". The valves controlling the use of plant process water are in continuous service.

The chance of valve trouble must be minimized here. It was accomplished by installing JENKINS valves . . . chosen on their record of dependable, long-life performance in critical services for almost a century.

YOU PAY NO MORE when you demand these famous valves for your jobs. And, you gain substantial savings through reduced maintenance and replacement of valves. Jenkins Bros. 100 Park Avenue, New York 17.



Jenkins Valves control process water to the rod mill, classifier sections and the acid plant. Also, lines in power house and heating system.

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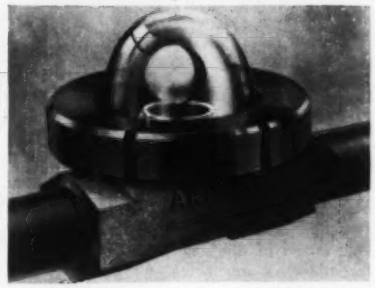


Ball Type Indicator

A simple, reliable indicator, developed by McIntosh Equipment Corp., shows clearly visible whether flow is taking place, by making the ball dance in a glass dome. If the flow stops, the ball drops out of sight.

Useful in applications such as air, steam, water, and oil purge lines to instruments and mechanical seals; cooling water to compressors, condensers, jacketed process vessels, laboratory equipment, and electronic equipment; lubricating oil to bearings; and many others.

The new Arkon ball type flow indicator is made in 1/2 in. pipe size for pressures up to 100 psi with die-cast bronze body, and either Nylon or Teflon ball. —K–1

Templates

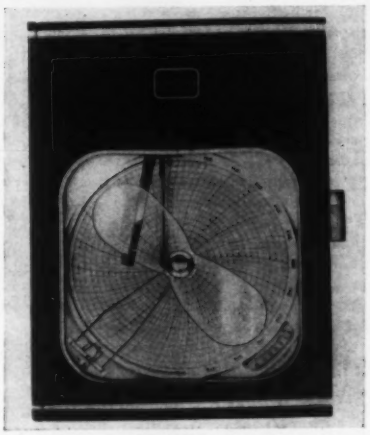
A complete new line of templates has been added to the Keuffel & Esser Co. list of drafting supplies. Consisting of 18 individual templates, the new line has been tradenamed Speedraft. Made of the highest quality transparent plastic, the templates are convenient-to-use, time-saving drafting tools for drawing accurately and easily a wide range of standard symbols and figures, circles, squares, triangles and ellipses—all in graduated sizes and scales.

In addition, the Speedraft line includes templates for use in specialized fields of drawing. These include architectural, store-layout, office-plan, electrical and electronic, and ductwork for heating, ventilating, and air conditioning. All apertures are precision cut individually for accuracy, with allowances for pencil thickness. —K–2

Spiroid Gears

Precision spiroid gears are the newest addition to the complete line of stock precision instrument parts and components made by PIC Design Corp.

Produced under a special license agreement with Illinois Tool Works, the new spiroid gears, in 1/8, 3/16, and 1/4-in. shaft sizes, offer the designer of small package assemblies added advantages in back-lash control, shock strength, noise level, and accuracy in high-ratio, right-angle-gearing applications. Multitooth-contact design provides inherent precision control unobtainable with other forms of low-contact-ratio gearing. Ask for Cat. No. 22. —K–3



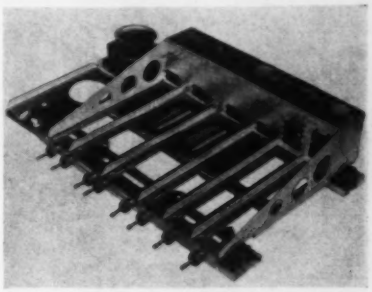
Time-Program Recorder Controller

The Bristol Co. is offering a single-case time-program recorder-controller in its Series 500 instrument line. The incorporation of the recorder and the controller into a single unit affords a 50 per cent reduction in panel-space requirements.

The recorder chart and the program cam are independently driven. This makes it possible to record repetitions of the program on a single chart. The program time may be from 30 min to 30 days.

Various models of the instrument measure and control temperature, pressure (including absolute pressure), flow (mercury manometer or bellows-differential meter), liquid level, and humidity.

Either pneumatic control or Bristol's Free-Vane electronic control is offered. Pneumatic control can be "on-off," or proportional or reset control. An external manual-automatic station is available.—K–4



Mounting Systems

New elastomeric mounting systems are being produced by Lord Mfg. Co. to meet requirements of an aerospace design trend calling for integration of "black boxes" and protective structures.

These custom designed, integrated mounting systems consolidate such avionic systems as communications, navigation, flight control, countermeasure, and fire control on one structural base. This affords the benefits of lower costs, reduced cooling and space requirements, use of common wiring, improved serviceability and unitized protection against vibration, shock, and noise.

Elastomeric members are Lord BTR (broad-temperature-range) mountings which provide all-attitude control of high-frequency vibration plus attenuation of shock and structure-borne noise from −65° to +300 F.

Dyna-damp, Lord's new integrally damped structural material is recommended for applications exposed to random vibration and high-energy noise.

Lightweight honeycomb-panel sections are used in mounting base designs permitting a wider selection of materials to meet custom requirement.

Many other materials such as steel, stainless steel, and magnesium also are being incorporated in construction of these units. —K–5

Explosive Cable-Cutter

A miniature electrically initiated guillotine which is rated to cut 3/32-in. stainless-steel aircraft cable, cuts by explosively forcing a chisel-type blade through the cable. The guillotine, made by Holex, Inc., is Holex 2234 featuring dual-budge wires, 99.98 per cent reliability. Other models are available with cutting capacities up to 1/2 in. The cutter withstands MIL-E-5272 environments. —K–6

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Compressed-Air Filters

King Engineering Corp. announces a line of compressed-air filters that remove practically 100 per cent of the entrained dirt, oil, and water from the air and normally operate for months without maintenance. The filters are for use with pneumatic instruments and controls, spray guns, vacuum pumps, and air-operated equipment of all kinds, and for cleaning of air used in processing. Maximum flow rates range from 20 to 200 standard cfm, and pipe sizes range from $^1/_4$ to 2 in. The filters employ a new operating principle (patents pending) that gives the air a scrub-and-polish treatment. On entering the filter, the air flows downward through a wet filter bed in a scrubber cartridge. This thoroughly cleans the air of dust and dirt particles down to 2 microns dia or less. In addition, mist and fog particles of oil and water coalesce and combine into larger drops as they pass through the wet filter bed. At the bottom of the cartridge, the liquid particles have been removed from the air and formed into large drops. These are too heavy to float in the air stream; and aided by the downward flow of air, they fall into a sump at the bottom.

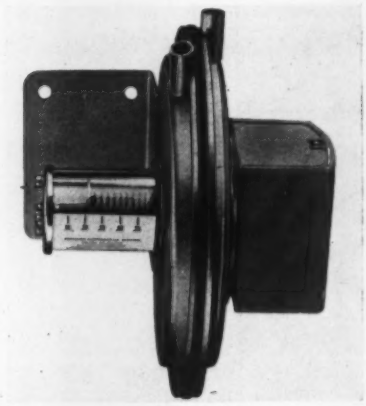
The scrubber cartridge is saturated with liquid at the factory to start the coalescing action, and its operation depends on its being saturated. Thus this cartridge is not replaced when wet with oil and water removed from the air, but keeps right on filtering. The down-flow of air continuously sweeps it clear of excess liquids. If loaded with gummy or resinous deposits, the cartridge may become clogged; but under all normal operating conditions, it works at full efficiency for many months without attention.

When the air leaves the scrubber cartridge, it reverses direction and passes upward and out through a dry-bed polisher cartridge at the top of the filter. The polisher cartridge removes practically the last remaining traces of water and oil, leaving the air exceptionally clean.

The scrubber cartridge does 98 per cent of the cleaning, so the polisher cartridge also lasts for many months. Both cartridges are disposable and simply replaced. Ask for Filter Catalog 6000. —K–7

Generator-Detector

Model 800–R generator-detector made by Electro Scientific Industries, is a combination of a variable power supply and a sensitive microvoltmeter. The generator provides six output ranges to match loads from 1 ohm to 100 kilohms. The output is continuously variable from 0 to 1 watt into a matched load. The isolation and guarding make the 800-R particularly applicable to high-accuracy bridge measurements. The detector consists of a modulator-type calibrated d-c microvoltmeter, with ranges from 0.2 microvolt per dial division to 1000 volts full scale. —K–8



Differential-Pressure Switch

A differential-pressure switch, made by F. W. Dwyer Mfg. Co., is designed for extremely accurate and reliable control in pressure ranges too low for conventional switches. Dead band is unusually small. One model of this new No. 1630 series differential-pressure switch, for example, may be set to open a circuit on a pressure-differential increase of only 0.05 in. of water and to close on a decrease of 0.03 in. Repetitive accuracy is within 1 per cent—there is virtually no error due to drift or hysteresis.

This switch is suitable for such applications as liquid-level controls, induced-draft interlocks, exhaust hoods, dust-collection systems, and air filters. Specific examples include low-air-velocity detection, control of air-curtain systems, counting devices, monitoring of pressurized rooms or areas.

The unit's pressure set point is easily visible on an accurate scale marked in inches of water. Calibration adjustments may be sealed or safety wired, making the switch tamper proof.

Switches incorporating explosion-proof or weather-proof housings, special diaphragms for extreme low temperatures, or "fail-safe" pilot lights are also available. Ask for Bulletin No. E-30. —K–9

Plug-In Dial Timer

The many advantages claimed for a new plug-in dial timer include: (*a*) Quick removal and easy replacement which cut costly down-time; (*b*) heavy, plated plug-in components; (*c*) a keyed guide-pin which protrudes through the rear of the case to accept a snap-in cotter-pin clip to assure secure engagement as well as maximum safety; (*d*) an optional front mounting clamp for installation where rear accessibility is impractical. A unique field conversion kit is available which enables all installed ATC Atcotrol timers to be converted to plug-in convenience.

Engineering Data Sheet No. 87 is available from Automatic Timing & Controls, Inc. —K–10

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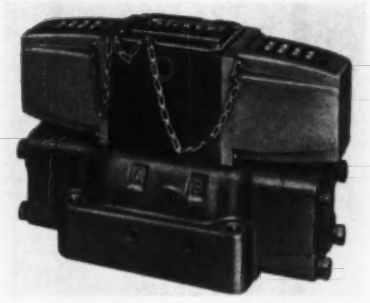


Directional Control Valve

Improved performance and uprated capacity are featured in this new four-way solenoid-controlled, pilot-operated directional valve announced by Vickers Inc., Div. of Sperry Rand Corp.

Although price and envelope size have remained virtually the same, the valve's nominal capacity of 30 gpm is 50 per cent greater than that of previous models. Another advantage, particularly with high-cycling machines, is the 300 per cent reduction in valve-centering time.

Exceptionally quiet and cool operation is a feature. The new valves are equipped with new Q-E-L (quiet-extended-life) solenoids that have four to five times the life of ordinary air-cooled solenoids.

The new unit is available with subplates having either $^3/_4$-in. pipe-thread connections for flows up to 20 gpm, or 1-in. connections for flows above this figure. —K–11

Flexible Couplings

Standard-duty type CQ and heavy-duty type HQ flexible couplings that incorporate one set of jaws in removable-ring form, permitting both independent rotation or radial removal of connected machinery, are available from Lovejoy Flexible Coupling Co. This feature is especially advantageous on gasoline, steam, or diesel-engine applications where the driven machinery must be disconnected in order to set or time the engine.

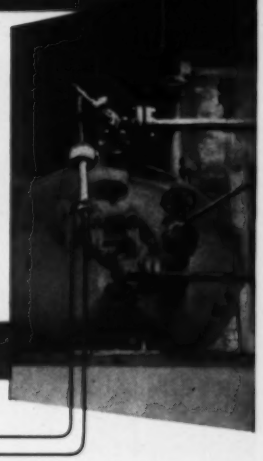
The couplings employ individual free-floating load cushions of material suited to the particular application. Since the full load is transmitted through cushion compression only, there is no wear on the metal jaws. Lubrication is never required.

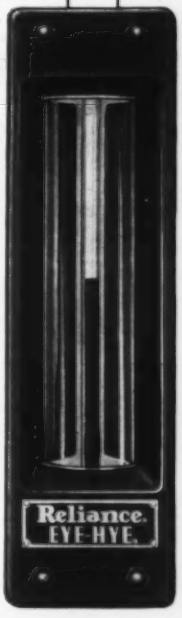
Pulling a removable jaw ring outward provides enough clearance for independent rotation of either end of the coupling. Simply by reversing a set of cap screws from one body to the other, connected machinery can be removed radially without disturbing power-transmitting elements of the coupling.

Type CQ Lovejoy flexible couplings are available with maximum bores from $1^3/_8$ to $5^1/_2$ in. They range from 2.58 to 156 hp at 100 rpm. Type HQ maximum bores range from $1^3/_4$ to $8^1/_2$ in., horsepowers from 7.77 to 810 at 100 rpm. —K–12

Why a remote reading gage

- Most boiler drums are high — direct gages are far from operating floor.
- Obstructions often make gages hard to see — necessitate special equipment or frequent climbing to inspect.
- Remote gage saves thousands of steps, hours of valuable time. Brings gage reading *down to eye level* at safe distance from boilers.





Why Reliance EYE-HYE

- EYE-HYE assures perfect measurement, dependability and clear reading.
- All-hydrostatic principle — no mechanical parts — no adjustments on location.
- Reads in liquid, like a conventional gage, but easier, faster because of illuminated green indicating fluid.
- Oldest practical remote gage — over 13,000 in use — on land and sea.
- Economical special attachment actuates supplementary alarms, audible or visible, if desired.

- Available for either wall or panel mounting, new wide-visibility EYE-HYEs are made for any pressure range — up to 3000 psi. Also long window model for unusual liquid level variation — for tanks, heaters, etc.

Write for catalog information on EYE-HYE for *your* boiler pressure.

The Reliance Gauge Column Co., 5902 Carnegie Ave., Cleveland 3, Ohio

Reliance BOILER SAFETY DEVICES

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Variable-Speed Drive

What is claimed to be the most compact and lightest fractional-horsepower variable-speed drive in the industry has been introduced by Sterling Electric Motors. The new fractional horsepower Speed-Trol has the shortest over-all dimension and is up to 15 per cent lighter than competitive units. Speed ranges from 4660 to 1.2 rpm with up to 10 to 1 variation are offered in 1/4, 1/2, and 3/4-hp ratings. Larger pulley diameters assure a cooler-running, longer-lasting belt.

Retention of important NEMA-standard dimensions for shaft height and diameter permit substitution with standard motors. Electrical characteristics and enclosures include single-phase, three-phase, drip-proof, totally enclosed, and explosion-proof.

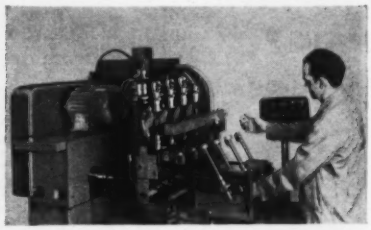
The new unit may be foot mounted in any position or can be furnished with face mounting bracket. It is available with right-angle and helical gears. **—K-13**

Temperature Sensors

Aero Research Instrument Co. has developed a complete line of thermocouple-type temperature sensors for use up to 4000 F. These are of the noncooled and cooled types to measure liquid, solid, and gaseous temperatures. Some of the sensors are usable in oxidizing atmosphere up to 4000 F and intermittently higher.

The applicability of these temperature sensors is accomplished by the use of refractory metals, that is, tantalum and molybdenum with special CR oxidation-resistant coatings. Insulation is magnesia and beryllia and thermocouple wires are iridium, tungsten, rhenium, and alloys of these elements.

These probes are designed for such typical applications as measuring the temperatures of: (*a*) Exhaust gas in an afterburner, (*b*) molten glass, (*c*) fuel pins of a nuclear reactor, (*d*) missile nose cone, (*e*) combustion processes, (*f*) flue gas (checkers, also), (*g*) crystal-growing ovens, and many others. **—K-14**



Boring Machine

A standard single-end Ex-Cell-O precision boring machine rough and finish bores aluminum die-cast valve-rocker shaft bearings, four at a time, in a total cycle of only 16 sec.

In operation, parts are manually loaded and radially located on a ram-type loader. This mechanism is subsequently moved downward and forward to feed the parts into their machining positions. The automatic cycle is initiated by the final movement of the loading mechanism. Automatic toggle clamps swing downward while a set of overhead pneumatic hammers taps the parts to ensure accurate seating on location pads.

The table moves rapidly to the left where both rough and finish boring are performed. Unloading is exceptionally rapid. As clamps are released, air pressure forces the workpieces from their positions and onto a conveyer which transports them to the rear of the machine. At this time air jets clear chips from location pads. **—K-15**

Gas Flow Meter

A gas velocity meter, which gives instantaneous, accurate measurement of the mass velocity of gas flow as it passes through a line, is being marketed to the gas industry by American Meter Co.

The instrument is designed and specially calibrated for use by gas utility companies. To obtain a velocity reading, a probe containing a sensing unit is inserted into the line through a standard 1-in. NPT pipe tap. Velocity is indicated directly on the meter. The velocity reading can be converted into standard cubic feet per hour from the quick-reference chart supplied with the instrument.

The meter can be used in the analysis of gas flow in a distribution system as a device for checking efficiency of existing operations, and for planning future expansions. Besides velocity, flow direction is indicated simply by depressing a button on the instrument.

The compact velocity meter is completely transistorized. It operates on a nickel-cadmium, rechargeable battery that can be recharged overnight in the instrument by plugging into any standard 110-volt, 60-cps electrical outlet. Battery life is about 10 yr. The instrument, supplied in a rugged Formica case, weighs 10 lb. **—K-16**

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Here's a fine product which adds to the comfort and safety of the home. There's a secure feeling developed when—after having been away from home all day—you come home in darkness to find a brightly-lighted house waiting for you. No stumbling and fumbling in the dark either, thanks to PROTECT-O-LITE made by Energy Kontrols, Incorporated. This thermal switch photo electric eye turns on the light at dusk, turns it off at dawn. The absence or presence of light causes the electric eye to energize or degenerize a resistor, causing the working bimetal to bend and actuate the control switch. A time delay eliminates false operation due to momentary flashes of light or temporary cloud movements.

The PROTECT-O-LITE is not a photorelay . . . Chace Thermostatic Bimetal serves as the actuator, doing two jobs: it drives the switch as well as providing the time delay. The PROTECT-O-LITE is temperature compensated over a range of −25°F to +150°F. The ambient compensator, also made of Chace Thermostatic Bimetal, assures dependable operation of PROTECT-O-LITE at any temperature.

Like many other respected companies, Energy Kontrols assures the extreme dependability of its products. The dependability of PROTECT-O-LITE is greatly affected by two small pieces of Chace Thermostatic Bimetal. But this is a familiar responsibility at Chace. In more than a third of a century of specializing in thermostatic bimetal, Chace has become recognized for the utter dependability of its only product: precision thermostatic bimetal

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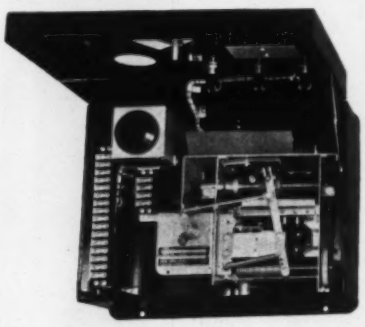


Lead-Lag Sequence Controller

The Master Monitor, made by Cleveland Controls, Inc., is for the sequence control of multiple-boiler installations. The equipment in a single compact enclosure will automatically operate a bank of boilers, compressors, or other units, so that only the required number are called on to meet the load demand.

Individual units are cut in and out of operation in response to predetermined pressure or temperature variations, or to any other signal. The lead unit is selectable at any time by simply turning an externally accessible rotary switch. Lag units always follow in numerical sequence. The lead unit may be changed as often as required.

The Master Monitor is adaptable to modulating, high-low, or on-off systems. One model is designed for use with boilers equipped with Honeywell Modutrol motors. Another is designed for use with Cleveland Controls actuators. Others can be used for simple line-voltage switching. Models are available for sequencing up to ten units.

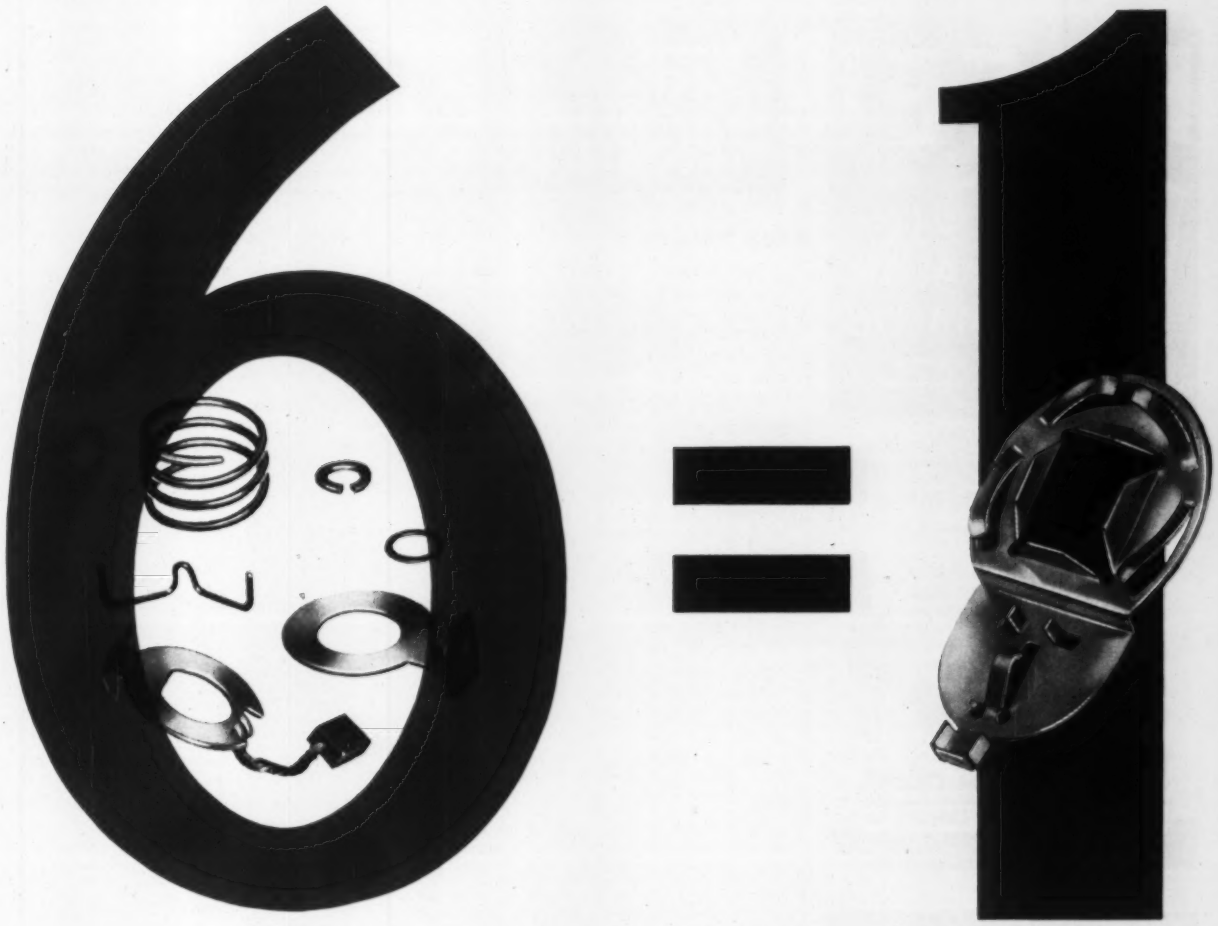
The Master Monitor can be applied to existing installations as well as to new construction, with a minimum of field wiring and set-up time. **—K-17**

Wear Rings

Filled nylon is now being used to fabricate piston wear rings for use in heavy hydraulic cylinder applications for off-the-road equipment. A product of Garlock Inc., they are available in a wide range of standard sizes.

Filled nylon offers many advantages to manufacturers of new equipment. The material has excellent wear resistance, requires no lubrication, and is used as bearings in many applications. It has a wide temperature range, remaining serviceable up to 350 F, has a low coefficient of friction, and will not gall cylinder walls on long-stroke pistons where canted reciprocation may be encountered.

For high-production cylinders the cost is nominal in comparison to normally used materials. Filled-nylon piston wear rings are available in most standard sizes ranging from $2^1/_2$ to $7^1/_2$-in. **—K-18**



6 = 1 with re-design 'rithmetic

One flat spring now does the work previously required of the six parts shown—and greatly simplifies assembly, too. This single multi-purpose spring (a) holds a carbon brush in a rheostat, (b) applies pressure on the wire windings, (c) provides friction detent action, (d) acts as a retainer on the rotating shaft.

How did this come about? The maker of the rheostat undertook a complete redesign analysis, called in an A.S.C. Spring Engineer when it concerned the spring.

Early consultation with A.S.C. springmakers in new or redesign projects gives greater range to plans, safeguards against high production costs. Our booklet, "Designing Springs for Performance," may help you. Write for your copy.

5902

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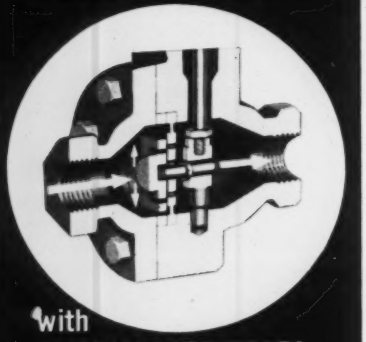

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Gate Valves

Consolidated Vacuum Corp. announces the availability of a new series of high-vacuum gate valves which incorporates features designed to overcome the disadvantages presently encountered in vacuum gate valves.

The new valves have large, unrestricted openings which insure greater conductance; up to 178 per cent more than other gate valves on the market today. Presently available with nominal 2, 4, and 6-in. openings, the valves are designed to mate with CVC's oil-diffusion pumps as well as numerous others without curbing rated pumping speeds as do other available gate valves.

The valve bodies are cast as a single unit to overcome the possibility of gasket leakage or outgassing near the flow path. Vacuum-cast aluminum is utilized to minimize porosity, a problem which in other gate valves has necessitated impregnation. As a result of this design, the valves may be used with operating pressures down to 10^{-6}mm Hg.

If cleaning or maintenance is required, a gasketed end plate permits easy removal of the valve operator without disrupting the line or system in which the valve is located. The unique design of this end plate also permits the customer to convert to the other available type of valve operators—manual throttling, manual quick-acting, and pneumatic. Write for Bulletin 10-2. **—K-19**

Quick-Connect Coupler

Spray which occurs when connecting or disconnecting a valved-coupler plain-nipple combination has been eliminated by a new series coupling introduced by Snap-Tite, Inc.

The ES series utilizes a positive metal-to-metal stop when the valve is in the closed position. This controls the compression and displacement of the valve seal.

An extra O-ring seal in the coupler, in addition to the E-packer seal, prevents spray when there is internal pressure on one side of the coupling.

The ES series, like its sister group E series, is designed for high-pressure, low-pressure, gravity-flow, and vacuum systems.

The new Snap-Tite series is available in two types of couplings, with both nipple and coupler valved for double shutoff or with valved coupler and plain nipple for single shutoff.

ES couplings are available in sizes from $\frac{1}{4}$ to 6 in. with a choice of seals for handling various materials. They are made in steel, brass, aluminum, 302 stainless, and 316 stainless and are available in cadmium plate, cadmium chromate, electroless nickel, chrome, nickel, anodized, and passivated, depending upon the choice of metal. **—K-20**

Metering-System Components

A new line of controllers, actuators, transmitters, indicators, and manual stations, made by Cleveland Controls, Inc. is for use in systems for accurate control of fuel and air in combustion processes.

New and exclusive features contribute to greater efficiency and economy in positioning and metering control. The basic transmission system is electronic. Individual components are designed to integrate multiple functions where possible in single enclosures, thus achieving lower initial cost, simplified installation, and less maintenance, because of fewer units per system.

A built-in, field-adjustable, characterizing cam eliminates the need for expensive, troublesome characterized oil or gas valves. The cam is characterized by simply turning a series of Allen-head adjusting screws. Any point on the cam can be adjusted, or re-adjusted to its original setting, at any time (not possible with cams characterized by filing). Another major advantage is offered by a "Duo-Fuel cam," available for combination gas and oil-fired boilers. This makes it possible for a single regulator unit to meter with either fuel eliminating a second unit. Changeover between fuels is simple and positive, but can be done in seconds. Interlock prevents operation with one fuel when the regulator is set for the other.

Positioning and metering systems of a wide variety of types for single and multiple-boiler installations, can be designed by the proper combinations of components. By the simple addition of a Cleveland air flow regulator, any positioning system can be made a metering system. **—K-21**

New 30-Ton Press

A newly designed 30-ton, four-column hydraulic trimming press for large dies, featuring high-speed advance to 1300 ipm has been announced by Hannifin Co. Div., Parker-Hannifin Corp.

Although capable of high-speed operation to 1300 ipm, ram speed may be reduced to 240 ipm at casting contact. Castings are then trimmed with a "squeeze" rather than a blow. This soft shearing action gives a cleaner, more accurate casting trim, reduces the danger of damage to dies and minimizes rejects.

Compact design of the new Hannifin press allows placement in areas near casting machines. This eliminates transportation and stacking damage to still-warm castings. Other models in the T4C series offer working capacities from 10 to 150-ton force.

The Series T4C 30-ton four-column hydraulic trimming press has 20-in, full stroke, 30-in. gap, ram speed of 1300-ipm rapid advance, 240-ipm feed, and 790-ipm return. Working pressure is 2120 psi max. It is equipped with 20-hp motor, 31-gpm pump, and 29 × 42-in. base. **—K-22**

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BUSINESS NOTES
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LATEST CATALOGS

Piping Insulation

Kaylo high-temperature insulation has an embossed, ripple-textured, protective aluminum jacket, and can be applied easily and quickly on industrial piping it is announced by Owens-Corning Fiberglas Corp. Known as Kaylo-Klad pipe insulation, the product is effective to 1200 F.

The jacket, which as a "no-glare" appearance, provides protection to the insulation against damage and weather. The longitudinal seam of the jacket snaps together with interlocking lips in one step for positive weather tightness and end joints are sealed with a band containing an integral sealing compound. Kaylo-Klad is easily removed for inspection or pipe repairs by removing the joint strap and sealer bands and separating the longitudinal seam.

It is manufactured in pipe sizes from $^1/_2$ to 24 in., ips, from 1- to 3-in. thicknesses, and for copper tubing from $^1/_2$-in. to $3^1/_8$-in. OD, in thicknesses of 1 and $1^1/_2$ in.

Kaylo heat insulations are made from a high-temperature reaction of lime and silica at Berlin, N. J. Other products in the line are standard Kaylo pipe and block insulations, effective to 1200 F, and Kaylo-20, effective to 1800 F. —K-23

Thread-Cutting Screws

Parker-Kalon now offers three new, improved thread-cutting screws for every application in every material.

The five cutting flutes on the new improved P-K Type F and B-F reduce pressure development by 80 per cent. The completely formed threads on these tapping screws have sharper cutting edges, and five deep flutes that are of continuous depth. These features make for better clearance of the accumulated material and assure minimum stresses in driving, and avoid the possibility of stripping or galling.

Type F cuts a machine screw thread as it is turned in. It is ideal for making fastenings in castings, forgings, sheet metal, structural steel, plastics, and resin-impregnated plywood.

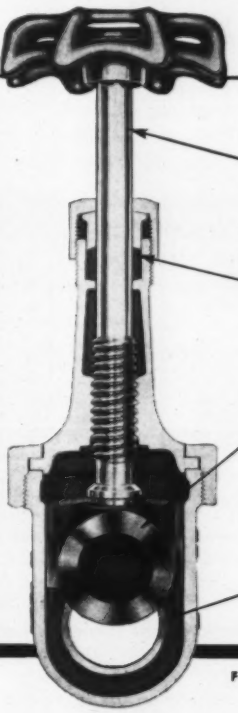
Pentap, the new Type B-F, combines the five thread-cutting flutes of Type F with the coarse-pitch, widely spaced threads of Type B. Type B-F distributes cutting pressure evenly, lets chips drop to the bottom of the hole, and prevents cracking of material. It is ideal for fastenings in comparatively thin sections and bosses in friable and brittle materials.

Type L is a completely new and improved screw developed by Parker-Kalon for use in nylon. Type L functions as a combination thread-cutting and thread-forming screw—in that it cuts a small amount of the nylon to allow the full-diameter threads to form. It is of particular advantage in nylon assemblies which must be disassembled for service, because the new Type L can be removed and replaced without stripping or galling. —K-24

Outstanding Valve performance with

KENNEDIZED DISCS

an entirely new development in bronze gate valve construction that extends service life beyond comparison . . .



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KENALLOY STEM . . .

Exclusive KENNEDY alloy that prevents dezincification and corrosion and provides smooth, non-galling threads and bearing surfaces. In a rugged use test, this stem withstood a mechanical loading of 18 foot-pounds closing torque and after 25,000 cycles was like new!

PACKING . . .

New type packing made of molded graphite asbestos with a Buna "N" binder required no replacement during or after 25,000 cycles.

KENNEDIZED DISC . . .

In punishing use tests, the super mirror finish of the KENNEDIZED disc actually improved with wear! Disc showed no galling or other wear marks after 25,000 cycles at 150 lbs. saturated steam pressure. This remarkable wear resistance is combined with an extremely low coefficient of friction, smooth sliding properties, excellent anti-seizure characteristics and corrosion and galling resistance. Tests and in-use results prove these discs set a new and unmatched high standard in valve performance.

SEAT . . .

Due to the low coefficient of friction and smooth sliding properties, the action of the KENNEDIZED disc actually improved the finish on the seat. Here, again, no galling was found on the seat after 25,000 cycles.

For the complete KENNEDIZED DISC story, write for Bulletin 574.

Fig. 325KD
125-Pound S.W.P.
Bronze Gate Valve.

KENNEDIZED DISCS
NOW AVAILABLE IN THESE KENNEDY VALVES . . .

FIG. 427KD
125-Pound S.W.P. Bronze Gate Valve—Non-Rising Stem, Inside Screw, KENNEDIZED Wedge Disc.
WORKING PRESSURES: Saturated Steam, 125 lbs.; W.O.G., Non-Shock, 200 lbs.

Fig. 325KD
125-Pound S.W.P. Bronze Gate Valve—Union Bonnet, Rising Stem, Inside Screw; KENNEDIZED Wedge Disc.
WORKING PRESSURES: Saturated Steam, 125 lbs., W.O.G., Non-Shock, 200 lbs.

Fig. 78KD
200-Pound S.W.P. 550° F. Bronze Gate Valve—Union Bonnet: ¼"-2"; Bolted Bonnet: 2½"-3"; Rising Stem, Inside Screw; KENNEDIZED Wedge Disc.
WORKING PRESSURES: Steam at 550° F., 200 lbs.; W.O.G., Non-Shock, 400 lbs.

Fig. 318KD
300-Pound S.W.P. 550° F. Bronze Gate Valve—Union Bonnet: ¼"-2"; Bolted Bonnet: 2½"-3"; Rising Stem, Inside Screw; KENNEDIZED Wedge Disc.
WORKING PRESSURES: Steam at 550° F., 300 lbs.; W.O.G., Non-Shock, 600 lbs.

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FRICTION AND WEAR IN MACHINERY

This English translation of Volume 12 of the Russian annual —Trenie i Iznos v Mashinkh—has been made to acquaint English-speaking investigators and students in the same field with the work in the Soviet Union, and thus enable them to avoid duplication and achieve an effective coordination of their research efforts. The coverage ranges from hydrodynamic lubrication and bearing performance to boundary lubrication, dry friction, and wear, with a number of contributions presenting original thoughts and conclusions, and novel methods of analysis.

Contents: Resistance to Abrasive Wear of Structurally Inhomogeneous Materials. Investigation of the Wear of Steel in the Presence of Water on the Rubbing Surface. The Influence of Structure on the Abrasive Wear of Cast Iron. Investigation of the Condition of the Surface Layers of a Metal with the Electron Microscope. Fundamentals of Developing Frictional Brake Materials. Relaxation Oscillations in Elastic Friction Systems. Friction Coefficient Analysis Applied to Two Rough Surfaces. On the Theory of the Oil Film in a Dynamically-Loaded Bearing. The Influence of Heat on the Fluid Friction in a Non-Loaded, Annular Oil Film. On Two-Dimensional Steady Flow of a Viscous Incompressible Fluid Having a Variable Viscosity in a Bearing. Analysis of Temperatures in the Pad of a Thrust Bearing in a Hydroelectric Generator. Possible Limiting Conditions of Hydrodynamic Friction in a Four-Ball Testing Machine. On the Frictional Regime in Oil Testing on the Four-Ball Machine. On the Action of a Sulfurized Lubricant. Bibliography on Friction, Wear, and Lubrication.

Published 1960 **$7.50***

THE ROLE OF VISCOSITY IN LUBRICATION

In 1958, the ASME Lubrication Division organized and sponsored a symposium to discuss the factors affecting viscosity, the sensitivity of machines to viscosity change, the criterion used by engineers in selecting viscosity of oils for machine parts, and also to bring out new knowledge on viscosity in service applications. All of this information is now accessible to those working in the field through the pages of The Role of Viscosity in Lubrication. It is presented in thirteen papers, each written from the standpoint of experience, and in the discussions thereon.

Contents: Effect of Temperature on Viscosity. Effect of Pressure on Viscosity. Effect of Rate of Shear on Viscosity. The Sensitivity of Equipment to Variation in Lubricant Viscosity. Sensitivity of Machines to Lubricant Viscosity. Lubrication of Roll Neck Bearings and Gear Drives in Continuous Rolling Mills. Effect of Viscosity on Hydraulic Systems. Viscosity and Related Problems in Engine Design. Selecting Lubricant Viscosity for Design of Helical and Worm Gears. Viscosity in the Lubrication Mechanisms of Rolling-Element Bearings. Gear Lubrication and Viscosity. Recent Research and Development Work in Rolling Bearings. The Effect of Temperature and Pressure on Viscosity as Related to Hydrodynamic Lubrication.

Published 1960 **$4.50***

LUBRICATION AND WEAR—*Being the Proceedings of the 1957 Conference*

Here, in the 104 papers listed below, will be found the kind of information that can be used to achieve greater economies in lubricants and maximum reduction in wear.

HYDRODYNAMIC LUBRICATION

Experiments on the Flow in Rotating Annular Clearances.
High-speed Highly Loaded Bearings and Their Development.
Energy and Reynolds Considerations in Thrust-bearing Analysis.
Finite Gas-lubricated Journal Bearing.
Effect of Wettability of a Lubricant on Journal-bearing Performance.
Surface Deformations in the Hydrodynamic Slider-bearing Problem and Their Effect on the Pressure Development.
Further Experiments on Stepped Thrust-bearings: The Effect of Step Height.
Theory of Rheodynamic Lubrication for a Maxwell Liquid.
Re-examination of the Stepped Thrust-bearing.
Predicting Sleeve-bearing Performance.
Investigation of Cavitation in Lubricating Films Supporting Small Loads.
Dynamically Loaded Journal-bearings of Finite Length.
Experimental Investigation of Temperature Effects in Journal Bearings.
Method of Designing Plain Journal Bearings for Steady Loads.
High Speed Journal Bearings.
Experimental Comparison Between Three Types of Heavy-duty Thrust-bearing.
Temperature Distribution Within Lubricating Films.
Some Characteristics of Conventional Tilting-pad Thrust-bearings.
Visual Study of Film Extent in Dynamically Loaded Complete Journal Bearings.
Experimental Investigation of Friction Loss in High-speed Plain Thrust-bearings.
Observations on the Performance of Air-lubricated Bearings.
On Grease Lubrication of a Slider Bearing.
New Fundamental Testing Methods Applied to Lubricants. Measurement of Mechanical Properties in Continuous Flow.
Film Extent and Whirl in Complete Journal Bearings.
Vibrations in Journal Bearings.
Some Scuffing Experiments in a Disk Machine.
Study of Bearings Under Failure Conditions.
Viscosity-Pressure Dependence of Some Organic Liquids.
The Foil Bearing.
Importance of Surface Finish, Loaded Area Conformity and Operating Temperature in Small-end Plain Bearings for High-duty Two-stroke Engines.
Nature of the Wear Protection of Mild Steel Caused by Phosphating.

BOUNDARY FRICTION

Experimental Check of Elementary Law of Boundary Friction (Dry Friction).
Friction and Wear of Diamond.
Theory of Stick-Slip Sliding of Solids.
The Friction and Wear of Various Materials Sliding Against Unlubricated Surfaces of Different Types and Degrees of Roughness.
Investigation of Size Effects in Sliding by Means of Statistical Techniques.
Probable Behaviour of Contacts in the Sliding Process.
Frictional Behaviour of Anodized Aluminum Surfaces.
Metal Transfer in Boundary Lubrication and the Effect of Sliding Velocity and Surface Roughness.
Calculation of Dry-friction Forces.
On Preliminary Displacement.
Properties of Model Friction Junctions.

BOUNDARY LUBRICATION

Importance of Oil-Metal Adhesion in Lubrication.
Vapour Lubrication and the Friction of Clean Surfaces.
Investigation of Boundary Lubrication in Kinetic Friction by Means of a Wire Tribo-meter.
Orientation and Frictional Behaviour of Lamellar Solids on Metals.
On Friction and Lubrication at Temperatures to 1,000°F. with Particular Reference to Graphite.
On the Influence of Grease Structure on Boundary Lubrication.

BEARING METALS; NOVEL BEARING MATERIALS; GLANDS AND SEALS; SOLID LUBRICANTS; SURFACE TREATMENTS

Compatibility Testing of Bearing Materials.
Electrical Sliding Contacts and Their Behaviour at High Altitudes.
Wear of Selected Molybdenum Disulphide Lubricated Solids and Surface Films.
Friction Wear and Surface Damage of Metals as Affected by Solid Surface Films. A Review of NACA Research.
Lubrication of Fluid Seals.
Wear of P.T.F.E. Impregnated Metal Bearing Materials.
Study of the Design Criteria for Porous Metal Bearings.
Mechanism of Lubrication in Porous Metal Bearings.
Study of the Lubrication of Synthetic-rubber Rotary-shaft Seals.
Friction, Wear and Physical Properties of Some Filled P.T.F.E. Bearing Materials.

BALL AND ROLLER BEARINGS; GEAR LUBRICATION

Recent Advances in Grease Lubrication of Ball Bearings.
Current Development Problems in High-temperature Aircraft Rolling Bearings.
Development of a Geared-Steam-Turbine E.P. Lubricating Oil.
Observations on the Movement and Structure of Grease in Rolling Bearings.
Influence of Load and Motion on the Lubrication and Wear of Roller Bearings.
Some Studies of Pitting Failure in Rolling Contacts.
Study of the Effect of Lubricant on Pitting Failure of Balls.
Testing of Marine Main-propulsion-gear Lubricants in Disc Machines.
Load-carrying Additives for Steam Turbine Oils.
Influence of Magnetic Fields and the Passage of Electrical Current on the Deterioration of Ball Bearings.

ENGINE LUBRICATION; MISCELLANEOUS LUBRICANTS AND APPLICATIONS; ADDITIVES

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Lubrication in Wire Drawing.
How the Crankcase Lubricating Oils of Internal-combustion Engines Alter During Use.
Flow Properties of Lubricating Grease.
Lubrication of Road Vehicle Engines and Worm-driven Axles With Particular Reference to Vehicle Fuel Consumption.
Liquid Sodium as a Lubricant.
Sulphur as an Extreme Pressure (E.P.) Lubricant.
Influence of Acidity of the Lubricating Oil on the Wear and Deposits Obtained in the Caterpillar 1-A Oil Test Engine.
Effects of Nuclear Radiation on Hydrocarbon Oils, Greases and Some Synthetic Fluids.
Some Problems in the Lubrication of Small Two-stroke Petrol Engines.

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The Electron Miscroscope in the Study of Wear.
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Recent Developments in the Theory of Elastic Contact Stresses: Their Significance in the Study of Surface Breakdown.
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Valves

PDQ air control valves that can be installed with restoration of production in 30 sec are offered by Hunt Valve Co. Their insertion on the line merely requires loosening two cap screws, twisting, lifting, lowering the spare valve, seating it with a twist, and tightening two cap screws.

The company has also introduced a new Series NCH design with subplate for a three-position hydraulic valve. The new valves, available in NPT sizes 1/2, 3/4, 1, 1 1/4, 1 1/2, and 2 for 9.4 to 110 gpm and pressures to 5000 psi, save space, simplify maintenance, and reduce costs, They operate with any hydraulic fluid, have a no-leakage package design, low-pressure pilot, and can be repacked and repaired in the plant. **—K-25**

Transformer

An economical pad-mounted transformer designed especially for commercial suburban areas with heavy low-voltage load concentration has been introduced by Allis-Chalmers. All unnecessary gages and accessories have been eliminated. This results in a modern uncluttered exterior with locked and tamper-proof high and low-voltage enclosures. No vault or fence is required.

High-voltage and low-voltage dry-type enclosures accommodate either cable or bus work. The entire enclosure lifts away from the transformer for complete freedom in making connections.

Commercial pad-mounted transformers are available in three-phase sizes, 225 through 1500 kva with high voltage 2400 through 13,800 (no taps) and with a low voltage of 208Y/120 or 480Y/277. **—K-26**

Angular Cutters

A Nelco carbide-tipped angular cutter is available from stock from Cutting Tool Div., Brown & Sharpe Mfg. Co., for milling angular grooves and dovetails.

The 45-deg angular cutter has generous carbide tips to facilitate regrinding without grinding the steel cutter body. It is available with two carbide grades—Series 200 for steel, and Series 300 for angular grooves and dovetails in cast iron, brass, bronze, and similar nonferrous materials.

Designed for use on arbor, the teeth have 0-deg rake and the cutter may be ordered with keyway in line with teeth or halfway between teeth for interlocking or ganging with Nelco carbide-tipped side mills, slab mills, and saws for multiple milling operations. Chamfer on the OD is 1/64 in. max and tolerances are ±0.015 on cutter diam and width.

The cutter is available in three sizes from 4 to 6-in-diam and either left hand or right hand. The 4-in. tools have 10 teeth.
—K-27

Drilling Machine

A deep hole drilling machine, revolving drill type, developed by Brown & Sharpe Mfg. Co., Machine Tool Div., provides flexibility, simplicity of set-up, and economical production of accurately drilled parts.

Utilizing the built-in advantages of rapid work-positioning and simplified tooling possible with knee-type construction, it eliminates the need for expensive and cumbersome fixtures normally required for accurate location of holes.

Machines provide capacities from 1/8 to 1 in. with a 12 or 24 in. feed stroke; spindle speeds and feed rates suitable for a wide range of work; rapid advance and return; vertical and longitudinal positioning with calibrated handwheel and crank to 0.001 in.; 28-in. longitudinal, 12-in. transverse, and 12-in. vertical travel, and a high-pressure coolant unit delivering up to 30 gpm and 2000 psi with filtering capability of 5 to 10 microns, built-in heat exchanger, and reservoir.

The unique zero-setting gage permits fast and accurate location of the table and workholding device in relation to the axis of the drill spindle.

Optional, extra-cost equipment includes step pulley for providing three spindle speeds; variable-speed drive for infinitely variable spindle speeds; power travel in all directions; adaptors for angular holes; drill heads with mechanical feeds (pick-off change gears) and drill heads with mechanical feeds having variable-spindle-speed transmission and pick-off change gears; 24-in. feed stroke; and optic setting arrangements for vertical and longitudinal positioning within 0.0002 or 0.0003. Special fixturing and accessories are also available for long-run applications.
—K-28

"Canned Pumps"

A new line of canned pumps designed for leak-proof handling of dangerous or expensive fluids has been introduced by the Moyno Pump Div. of Robbins & Myers, Inc.

The new unit is a completely self-contained motor-pump in which the material being handled circulates within the motor. The pump impeller is connected directly to the motor shaft. Accordingly, no seals, packing, or stuffing box are required and the pump is thereby completely leak-proof.

The motor rotor and field are encased in stainless-steel "cans," heliarc welded during fabrication to isolate them from the material being pumped. The pumped fluid lubricates the entire unit.

Every wettable part of the pump, except the Graphitar bearings, is made of Type 316 stainless steel, thus assuring sanitation and corrosion resistance.

The pump is designed for all-angle installation and is therefore well suited for use in close quarters. It is available in 1/2, 3/4, and 1-hp ratings with capacities to 63 gpm.
—K-29

Welded Copper Tubing

Electronically welded copper tubing is being produced by Tubotron, Inc., an affiliate of Eastern Rolling Mills, Inc. The high-speed operation, employs the patented Thermatool process, extending the advantages of electronic welding to copper and brass tubing.

Until recently, copper's chief virtue of 100 per cent electrical conductivity has defied electronic welding. The high-frequency Thermatool process with a power capacity equal to that of three average television stations, now makes such welding possible on a commercial scale. The method provides closer gage tolerances and significant cost savings.

Tubing can be made with ODs from $\frac{1}{2}$ to $3\frac{1}{2}$ in. and with wall thicknesses from 0.017 to 0.140 in. In addition to copper and brass tubing, the company can produce electronically welded tubing, round and shaped, from all other metals including the exotic alloys.

All tubing produced will be electronically inspected and pressure tested by Tubotron. Light-wall copper tubing has been certified by an independent testing laboratory to withstand more than 2000-psi hydrostatic pressure. This is eight times the test pressure required by ASTM for the size and wall thickness of the tubing involved, and twice the maximum test pressure required by ASTM for any copper tubing. —K-30

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MECHANICAL ENGINEERS' CATALOG
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Prefabricated Piping

A new, prefabricated piping system for the overhead distribution of steam, hot water, process liquids, and refrigeration lines, called Plasti-clad, is announced by Ric-Wil, Inc. Pipe and insulation are covered with aluminum foil, over which are two wrappings of fiberglass cloth integrated within the Plasti-clad material. A final color coat of Plasti-clad is applied to finish the unit. Standard color is green, however alternate colors are available. The entire system is factory prefabricated complete with expansion loops, anchor units, elbows, and T-units ready for installation. Straight-run units are prefabricated in 21-ft lengths, pipe joints can be either field welded or threaded. Materials for insulating and sealing of field joints are furnished. Poles, hangers, saddles, and other accessories are supplied at optional extra cost.

The new plastic-coated system for underground distribution consists of pipe and insulation covered by a spiral welded metal conduit. The conduit is protected against soil and stray-current corrosion by a 20 to 25-mil coating of cold-cured epoxy coating. The coating is reinforced with fiberglsas cloth. It is highly resistant to acids, alkalis, and salts. The material has a high dielectric strength and will withstand a 10,000-volt spark test. The coating is resistant to continuous temperatures of 375 F and does not crack or cold-check at low temperatures. Thermal coefficient of expansion is nearly the same as for steel so that expansion and contraction of the conduit will not rupture the coating. All units are factory prefabricated in sections as required by job conditions. Joints are field welded and material is supplied for making final closures after testing. —K-31

Dust Scrubber

A new high energy dust and fume scrubber, the Oriclone, has been introduced by Ducon Co.

The unit is described as one of the few wet collectors whose performance can match that of the electrostatic precipitator. It is said to be ideally suited for control of acid mists, tar fog, petroleum coke dust, fumes from metallurgical operations, catalyst dusts, and other fine particles. The company says a unique feature of the new scrubber is its adjustable rectangular orifice, which is advantageous in processes where operating conditions vary. For example, should gas flow to the scrubber drop off at a particular point during a process cycle or during specific periods of low velocity, the orifice opening can be adjusted mechanically to obtain sufficient gas velocity to maintain the desired efficiency.

High efficiency in excess of 99 per cent can generally be obtained through the use of the adjustable orifice, for capacities ranging from 50 per cent below to 20 per cent above the rated capacity of the unit, the company states. —K-32

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Screw Feeder-Driver

Parker-Kalon, manufacturers of a complete line of thread-cutting and thread-forming tapping screws, today announced its new JS-60, latest development of the company's Jet-Setter. The JS-60 is an automatic screw feeder-driver adaptable to all standard pneumatic and most electric screw drivers.

The new JS-60 model is completely redesigned, with a cover housing that protects the inner mechanisms. It is easily portable to any point of the production line, and can be speedily connected to any suitable air line. Adjustable for use with screws of any diameter from No. 2 through No. 14, the new JS-60 is also quickly convertible to any driver such as Phillips, slotted, hexagon, or clutch, and any head style, making short-run production practical whenever desired. In addition, the JS-60 feeds and drives preassembled fastener-washer combination such as Sems.

The large motorized hopper holds and feeds up to a full day's supply of screws, and operation is so simple that even inexperienced operators can drive 40 to 50 screws per minute without fatigue.

Dowelled construction is characteristic of this precision-made machine, and all parts of the JS-60 are completely interchangeable. Time-consuming handling of screws is eliminated, and the smooth, continuous operation of the JS-60 increases productive output in every application. —K-33

Tank Brass

Development of a less expensive, lighter, more enduring tank brass for automobile radiator tanks has been announced by Chase Brass & Copper Co., a subsidiary of Kennecott Copper Corp. The metal is claimed to be the first major improvement in tank brasses in many years, and is now in production by Chase.

Called "Hi-Strength" tank brass, the metal is produced by a unique mill process developed by Chase's Research & Development Dept. "Hi-Strength" tank brass offers the following advantages over the conventionally used tank brass (dead-soft): 53 per cent greater yield strength, 15 per cent greater average tensile strength, 33 per cent greater fatigue strength plus high ductility and an extremely smooth surface finishing. In addition, it has greater resistance to stress corrosion than presently used tank brasses because of an inherently finer grain size.

Radiator tanks made from lighter gages of this new brass have shown no signs of failure under normal operations with standard radiator mixtures. The radiators were installed in 1958 and 1959-model test cars.

Field experience with this metal has shown that automobile radiators have withstood a 50,000-cycle test without failure despite the metal strip being 10 per cent thinner than conventional material. —K-34

Weigh-Feeder

A completely new, compact, precision weigh-feeder is now offered for small-capacity plastics injection-molding machines. Designed with a maximum weigh-bucket capacity of 10 oz and under, this weigh-feeder is designed to fill the demand for small-capacity injection-molding presses.

Developed by the Exact Weight Scale Co., this weigh-feeder is designed for mounting on the molding press in place of the regular volumetric hopper. The feeder will automatically weigh and deliver plastics charges to the press with precision accuracy. Weighing of the charges in this manner helps to save material, improve quality of the molded parts, reduce cycle time, and minimize rejects.

The weigh-feeder consists of a precision exact weight scale with over-and-under indicator, 50-lb-capacity spun-aluminum supply hopper, and stainless-steel net-weigh hopper and dump mechanism. Fully electric in operation, the unit requires no compressed air.

Hinged plastic sides completely enclose the weighing mechanism to prevent contamination, provide easy access and a clear view of the scale and mechanisms. Changeover to a new weight is quickly accomplished by changing the counter weights, moving the poise on a graduated beam or both.

This new small-capacity precision weigh-feeder is now offered, as an addition to the standard line of four plastics weigh-feeders with capacities up to 200 oz. —K-35

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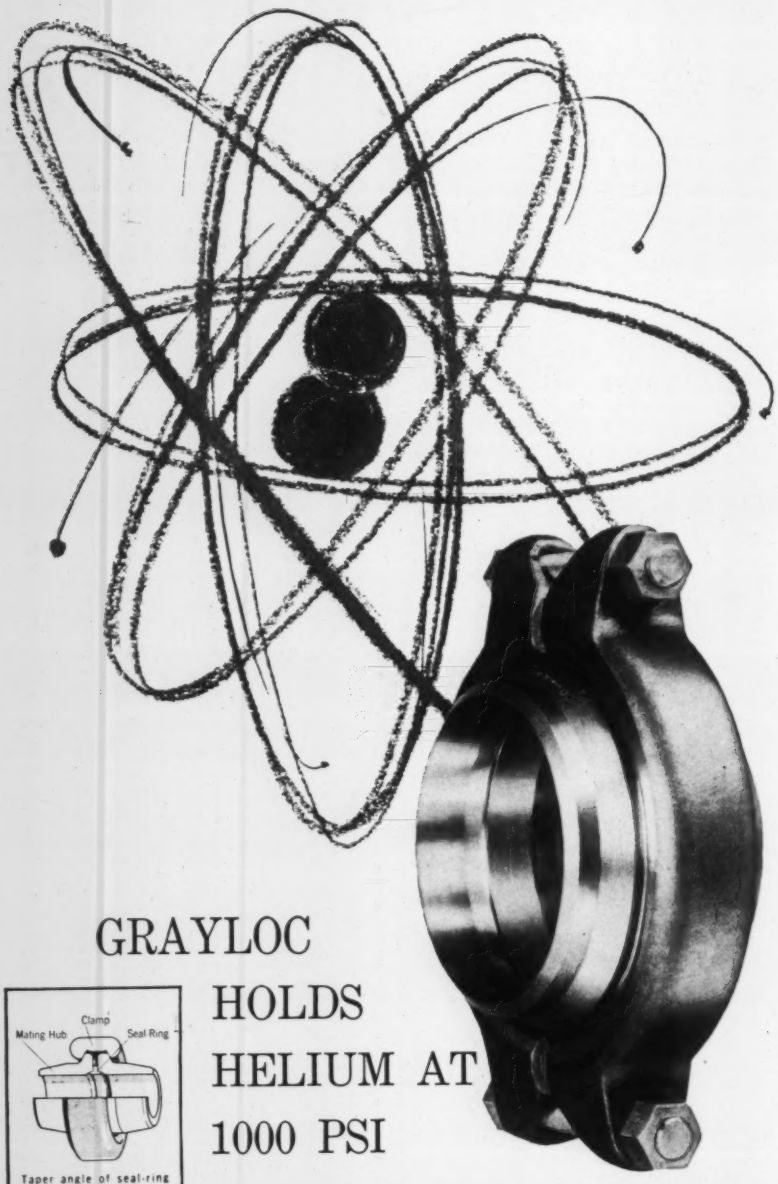

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Compressors

Two compact heavy-duty air compressors are available from Gardner-Denver Co. The two-stage LB and single-stage LA compressors are designed for greater efficiency and durability. The two-stage LB model for pressures to 1000 psi, ranges in size from 50 to 120 cfm. A single-stage model, the LA for pressures to 125 psi, is available from 71 to 240 cfm.

Maximum interchangeability is realized by using the same parts on all comparable sizes. A new water-cooling design affords more efficient use of power. A positive-pressure lubrication system is assured by means of a gear-driven rotary oil pump. Aluminum pistons allow lighter weight, improved balance, and less vibration. The crankcase and cylinder are separate components eliminating costly replacement of complete parts due to breakdown. The main bearings are adjustable tapered roller bearings. All sheaves are grooved for the latest design in V-belts. **—K-36**

"Mach-2" Valves

A new line of three-way and four-way air valves rated for 1000-cpm continuous duty is announced by Barksdale Valves. Known as Crescent "Mach 2," the new valves feature design innovations that lengthen coil life and improve valve performance through use of an extremely short solenoid-plunger stroke ($^3/_{32}$ in.) and reduction of friction in both pilot and main-valve members. Rated at 150-psi air, the valves are available in $^1/_4$ to $^3/_4$-in. pipe sizes. Although rated at 1000 cpm cycling speeds as high as 2100 cpm have been reached for intermittent periods of 20 min. During a 2-hr test at a speed of over 1500 cpm, the coil temperature stabilized at 7 C below the maximum code limit for class-A coils.

The direct relationship between high cycling speed and valve endurance is stressed by the manufacturer. The short solenoid-plunger stroke, essential for fast operation, greatly reduces coil heating. Friction reduction in the pilot valve, necessary for speed, is accomplished by use of a smal ball which seats on O-rings at both ends of a pilot cartridge. The ball moves freely, independent of the seals. There is no O-ring drag on the pilot plunger because it requires no seals. Similarly the main valve seats seal on O-rings. In the sealed position, metal shoulders take the shock in such a way that the O-ring seal is merely kissed by the main valve seat. As the rings are only minutely flexed they do not fatigue or lose their resilience.

All valves are mounted on subbases for easy maintenance and an entire valve may be released without disturbing plumbing by unscrewing four captive bolts. Threaded conduit connections, captive cover clamps, and body screws further simplify installation and servicing. **—K-37**

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MECHANICAL ENGINEERING—JANUARY 1961—**Keep Informed Section**

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KEEP INFORMED

BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Pump-Pulsation Eliminator

Pump pulsations are reduced to 1 per cent or less of system pressure by a new and ingenious device known as a High-Pressure Ripple Filter, which is a pump-pulsation eliminator and noise trap for all classes of liquid pumps.

Auto-Control Laboratories, manufacturer of missile and aircraft test equipment, states that the new device has no moving parts, contains no elastomer or flexible seals or members, and is compatible with all liquids. The units are available in unlimited flow ranges, working pressures to 25,000 psi, and temperatures from −450 to +1000 F.

—K–38

Load-Cell System

An unusual new remote-indicating load-cell system developed by W. C. Dillon & Co. permits instantaneous, direct readings of forces, in pounds, at distances over 1000 ft from the actual cell. Applications are found wherever site proximity is inconvenient, dangerous, confined, or outside of naked-eye range.

All industries have use for the Dillon remote-reading load-cell system. Typical examples are on cranes and hoists for weighing steel scrap and sheets; handling ore in mining operations; electronic scales; measuring structural stresses in wind tunnels; measuring jet-engine thrusts; checking tension on fishing-net and mine-sweeper towing cables; adjusting and maintaining proper tension in catapault and arresting gear on aircraft carriers.

The load-cell system utilizes an exclusive differential-transformer principle. All tubes, amplifiers, and expensive, troublesome circuitry have been eliminated by a special inverse-ratio circuit which carries sufficient voltage for integral magnification. The temperature-compensated circuit utilizes semiconductors entirely. Separate reference charts, conversion tables, and circuit balancing are also completely eliminated.

As many as four load cells may be used with one indicator which totalizes individual loads. Typical applications for multiple cells are found on electronic platform scales and setups measuring structural stresses over extended areas.

Dillon load-cell systems are claimed to cost approximately 50 per cent less than conventional strain-gage types and take up only about one-fifth the area.

They are available in tensile, compression, or combination push-pull types in 27 capacities from as low as 0 to 150 lb up to as high as 0 to 200,000 lb. Also, a wide variety of connectors such as swivel hooks, cable sockets, threaded studs, and so forth, are available as accessories. All cells are fully sealed. Most capacities are made of beryllium copper. Explosion-proof versions can be supplied on order.

—K–39

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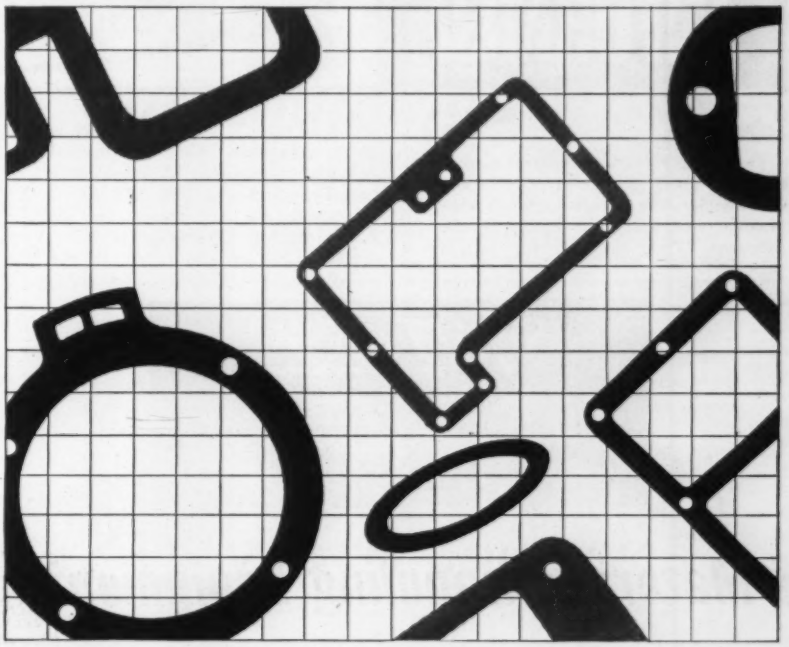

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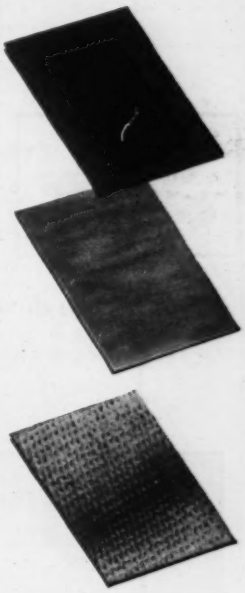
• RL-638 for extreme heat, flame penetration resistance



R/M FLUOROBESTOS* is a high grade, long-fiber asbestos unwoven sheet thoroughly impregnated with Teflon.† It has the same sealing and physical characteristics as compressed asbestos sheet, with the added benefits of Teflon. Deformation under load at 500°F (2000 psi) is only 0.1%.

R/M No. A-56 is a compressed asbestos sheet made from spinning-grade long asbestos fiber and a nonreverting compound binder. Average tensile strength of 8000 psi. The only compressed asbestos sheet made commercially in thickness of .008 in. ±.001 in. It has high heat resistance—is withstanding flange temperatures of 900 to 1100°F where internal temperatures are as high as 1400°F.

R/M No. RL-638 is a wire-inserted, woven asbestos fabric coated with neoprene compound and aluminum finish. It is ideal for use as seals against extreme heat and where high-temperature (2000°F) flame penetration resistance is required. Its light weight is a plus value. Meets FAA Specification CAR-04b-075 (a) for Fireproof Materials FAA Release #259, Section 1, Part B1.

*Registered trademark for R/M reinforced asbestos Teflon sheet.
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NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Tube Clamp

Two pipes or tubes of different diameters can be firmly held together at right angles with a device, called a right-angle tube clamp. Manufactured by Hunter Spring Co. Div., American Machine & Metals, Inc., the clamp adjusts to the pipe diameter in any given application. Only one manual adjustment is required. A threaded bolt is passed through one pipe and drawn up. Tightening the nut causes the clamp's jaws to tighten on both pipes at once.

—K–40

SYNTRON
VIBRATORY
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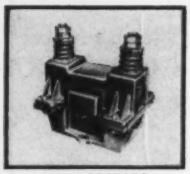
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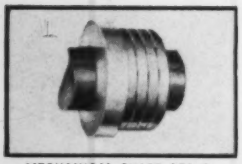
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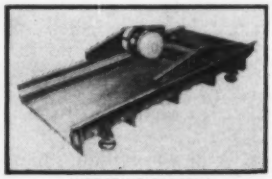
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Immersion Heaters

The Brown Fintube Co. has announced a line of their fintube-fired immersion heaters with improved heat-transfer and thermal characteristics.

These U-shaped units are used to heat or maintain at pumping temperatures asphalt and heavy oils in tanks for loading, blending, or storage purposes. Made in two sizes, an 8 and a 10-in-dia tube, they are also used on fluids where no steam supply is available or where asphalt and Bunker-C oil must be heated to temperatures higher than normal steam practice allows.

Fired with either gas or oil, the 8-in. firetube has a capacity of 750,000 Btu per hr, and the 10-in. firetube 1,250,000 Btu per hr. Higher capacities are obtained by installing multiple units.

Unique feature of these heaters is the use of a special perforated fintube design. These new fins permit higher rates of heat transfer and accelerate thermal currents within the tank. Material adjacent to the perforated fintube circulates more freely, is heated faster, and rises rapidly due to its lowered specific gravity. This prevents stratification of the material, keeps the heating surface clean, and reduces sedimentation.

The patented Brown finned firetube provides 5 to 10 times the surface area of bare tubes and permits more heat to be transferred per square foot of surface at lower wall temperatures. This minimizes overheating and possible damage to the material as well as coking and residue buildup on the tube. It is common to maintain the maximum wall temperature less than 200 F above the hottest fluid temperature.

The heaters are installed 1 ft off the tank bottom. A sliding support holds the firetube at the free end. The normal tank outlet is installed immediately above the immersion heater to pump the hottest liquid and maintain tank liquid level above the heater. For venting an ordinary sheet-metal stack the same diameter as the firetube is run up to the top of the tank.

Complete combustion, flame-safety, and automatic-control equipment of the latest design and similar to that used on other Brown heaters is furnished. The 8-in. tube with legs on 24-in. spacing extends 16 ft, 6 in. inside the tank, has 344 sq ft of heating surface, 60 1-in.-high 0.035-in. fins per tube, and weighs 1300 lb. The 10-in. tube with legs on 30-in. spacing extends 22 ft inside the tank, has 576 sq ft of heating surface, 72 1-in.-high 0.035-in. steel fins on each tube, and weighs 2300 lb. Tubes in both cases are Schedule 40 seamless pipe. Ask for Bulletin 400.

—K–41

FOR CONSULTING ENGINEERS
TURN TO PAGE 199

KEEP INFORMED

BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Air Conditioning

An entirely new line of packaged central-station air-conditioning units, featuring a complete selection of "Better Air" filters, has been introduced by American Air Filter Co. The new Kennard-Nelson units offer a complete central-station package where all components, including fans, coils, humidifiers, dampers, filters, frame, and casing are designed, fabricated, and tested by one manufacturer.

A complete selection of both unit and automatic air filters is available as preselected and matched components of an air-conditioning unit. The new Kennard-Nelson air-conditioning units are not only engineered to meet exacting conditions of air quantities, temperatures, and humidities, but also to provide any degree of air cleaning—all in one package.

Several unit-construction features have been incorporated into the basic-unit design. A Penta-Post frame, five-angle corner post, all-welded construction of heavy-gage steel, which provides maximum strength and stiffness with minimum weight—a double-drain pan with 1-in. insulation between the pans and a choice of metals for the pans to permit flexibility—opposed-blade dampers for uniform air distribution,—insulated panels with quick-opening access doors.

Air filters available for the particular situation include Amerglas throwaway, HV2 permanent cleanable unit filters, and automatic filters such as the automatic renewable media Roll-O-Matic, and the Rollotron, a combination dry electrostatic with the automatic renewable-media filter.

The new Kennard-Nelson line is available in both horizontal and vertical models in 14 basic sizes, with 24 different arrangements per size—500 to 36,000 cfm. Both forwardly curved and backwardly inclined centrifugal fans are offered against static pressures up to 9.0 in.

There is complete flexibility of coil choices and a full line of accessories. Ask for Bulletin No. AC-100. **—K–42**

Three-way Valves

A new line of two-way and three-way solenoid valves for pressures to 3000 psi has been announced by Fluid Power Accessories, Inc. manufacturers of hydraulic valves. Poppet construction of two-way valves assures leak-tight sealing when closed. Hardened-and-ground steel working parts in aluminum housing are used insuring durability. Available in 1/4, 3/8, and 3/4 in MPT for a-c and d-c voltage.

The three-way valves are operated by direct spool. Selectively fitted steel spools in a steel housing are used in the construction. Available in 3/8-in MPT size for a-c voltage maximum working pressure is 2000 psi. **—K–43**

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When you buy a Fast's coupling, you can bet your bottom dollar everything was built on the spot, not assembled piece by piece from other suppliers. Koppers multi-million dollar manufacturing facilities are the most modern in the industry . . . with advanced program machines, highly accurate gear shapers, a complete forge shop.

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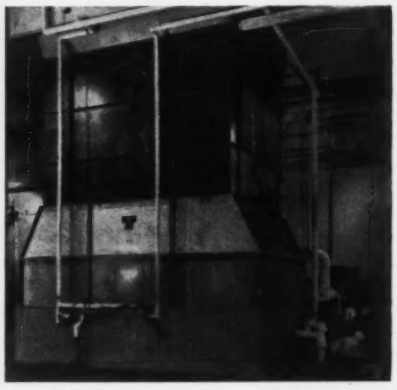

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KEEP INFORMED

BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Catalyst Carrier

A new, large-pore catalyst carrier has been developed by Norton Co. Known as Macroport A Alundum catalyst carrier, this ceramic medium is available in a variety of sizes having pores ten times as large as those in other standard Norton catalyst carriers.

The large pores permit gases or liquids to enter and diffuse within the structure of the carrier, providing optimum control of the reaction. These carriers meet critical chemical inspections during manufacture to prevent the inclusion of any chemical "poisons" such as iron, chlorides, and sulfur. Physical inspections insure uniform qualities of porosity, water absorption, and packing density.

Macroport A catalyst carriers are currently available as spheres, pellets, and granules of fused aluminum oxide in the same price ranges as standard Norton carriers. A research program is now underway to develop these carriers of other materials such as silicon carbide and silica for specialized applications. —K–44

BUSINESS NOTES

Firm Purchased

The Louis Allis Co., Milwaukee, Wis., has purchased the Dynapar Corp., Skokie, Ill., as a first step in a long-range program of expansion and diversification. The Dynapar electronic controls can be marketed not only as a separate and distinct product line but also in conjunction with Allis' adjustable-speed drive equipment to offer a more complete line of adjustable speed drives to industries requiring automated processes.

LATEST CATALOGS

Glass-Protected Smokestacks

Up to three to five times longer protection against corrosion is claimed for glass-protected smokestacks made by the A. O. Smith Corp. and described in a new bulletin. Special corrosion-resistant glass is fused to the steel to form a virtually impervious protective coating that weighs only about 5 oz per sq ft compared with conventional inside linings which weigh up to 50 lb per sq ft. Sections are simply bolted together and require no welding or painting. —K–45

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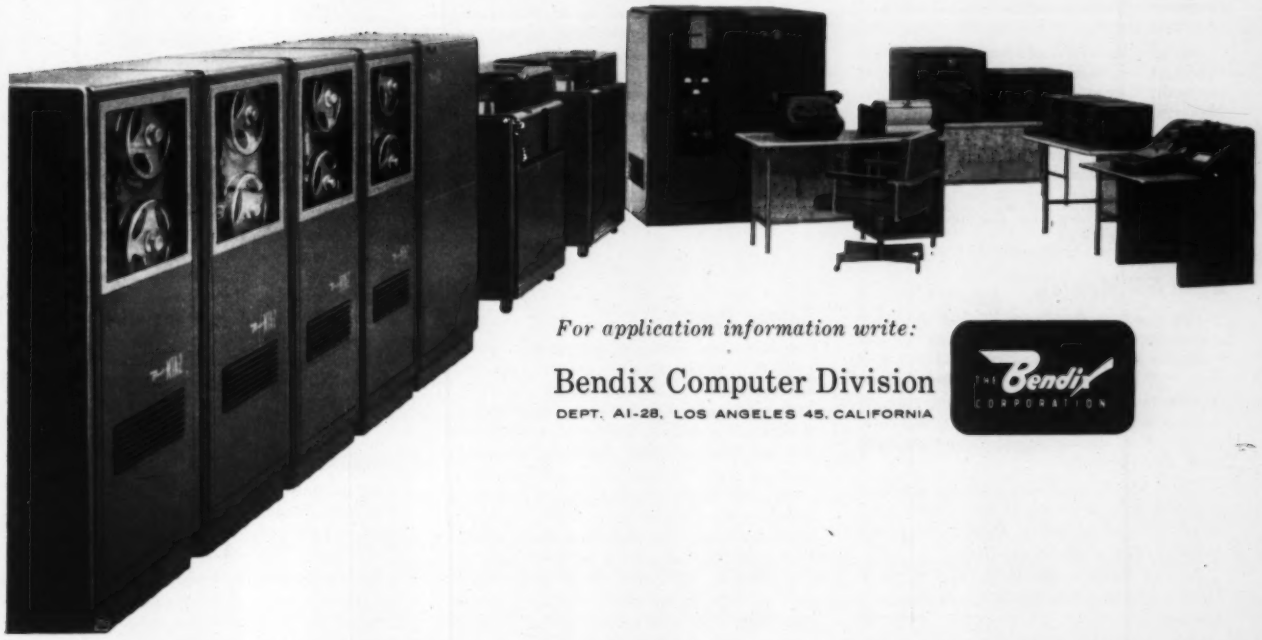

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KEEP INFORMED

BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Cement Additives

Placewel and Retardwel, two liquid admixtures for concrete, are described in a new four-page brochure, CA-6A, issued by Johns-Manville Corp. Placewel is for water-reduction and Retardwel for control of setting and water reduction. Data are supported by charts and tables resulting from test findings.

Advantages described for Placewel, include reduction of water without reduction of strength, increased durability and workability, and decreased shrinkage, and permeability. Advantages described for Retardwel in warm-weather operations include reduction of water requirements and shrinkage and increased durability and 28-day compressive strength. The brochure also includes suggested specifications. **—K-46**

Small A-C Motors

The Robbins & Myers line of small a-c special-application motors, offering 16 different hp ratings between $^1/_{100}$ and $^1/_3$-hp, is described in an eight-page bulletin. These motors have been designed for quiet running in small areas, with most frequent uses coming in office appliances, blowers, fans, and small electric tools.

There are 32 specific models in the line, resulting from a choice of four frame sizes, three types of mounting, three pole speeds, and four types of motor design.

Ask for Bulletin 445 from the Fractional HP Motor Div., Robbins & Myers, Inc. **—K-47**

Tubing

"Superior Tubing for Aircraft, Missiles and Rockets" is described in Bulletin 372 issued by Superior Tube Co.

Included in the 12-page bulletin is tubing for fluid-handling lines, including hydraulic tubing; for engine applications such as jet-engine components, for heat exchangers, rocket-engines, and push rods; for aircraft-instrument and accessory applications such as push-pull control conduits, Pitot tubes, venturi tubes, manometers, thermocouples, bellows, pressure gages, and fire-detection and extinguishing systems; and for air-frame applications such as ducting and pneumatic systems, structural parts and cabin decoration. **—K-48**

Canned Pumps

Goulds Seal-less (Canned) pumps are described in a new four-page data sheet, No. 728.1. Built in two sizes for capacities up to 100 gpm and for heads up to 100 ft these pumps are positively leak-proof as they have no mechanical seals, stuffing boxes, or glands. Recommended for handling volatile, toxic, or inflammable liquids, they are also widely used for pumping costly liquids as there is no loss of pumpage and contamination is eliminated explosion-proof construction can be furnished. Available in ductile iron or Type 316 stainless steel, with maximum liquid temperature of 350 F. **—K-49**

Fluid Flow Measurement

Two types of magnetic and electronic instruments for accurately measuring fluid rates of flow and warning of abnormal flow rates are described in Bulletin 18A, released by the Instrument Div. of Schutte and Koerting Co.

Both types are made to activate a warning light or alarm device, and will start or stop a pump, motor, or control unit. They provide high accuracy for critical applications.

The magnetic alarm rotameter uses a float extension rod with an encapsulated magnet. One or two sensing devices are mounted on the extension-rod housing tube. Each device contains a magnet and an hermetically sealed, vibration-proof reed-type alarm switch which activates a high or low-flow alarm or "start-stop" switch. Reset is automatic.

The electronic alarm rotameter does not require an extension-type float or housing. It uses an electric coil outside the metering tube to detect the position of the float. It can be set for high or low-flow alarm. **—K-50**

Steam Condenser

An eight-page catalog, W-503, from C. H. Wheeler Mfg. Co. describes that company's reverse-flow "self-cleaning" steam condenser.

This patented design eliminates down time for cleaning condenser tubes and tube sheets where circulating water is polluted by trash, leaves, grass, algae, silt, mussels, or other foreign matter. A hydraulic cylinder actuates valves or sluice gates without loss of vacuum. Flow may be reversed at full load. **—K-51**

Shaped Wire

Request the new edition of Shaped Wire Catalog DH-1226-A from Page Steel & Wire Div., American Chain & Cable Co.

A 16-page catalog covers Page Steel & Wire Div. facilities for providing wire of various analyses preshaped to a desired cross section as a help to the user in reducing his production costs and improving the design of his product. It also contains helpful information on methods of calculating areas of common shapes, physical properties of steel wire, table of standard wire gages, and hardness conversion tables. **—K-52**

Variable-Speed Drives

A new 16-page, catalog of the 400 Series Zero-Max stepless variable-speed drives for fractional-horsepower applications is available from the Zero-Max Co.

Typical applications, operating features, and installation suggestions are described, with tips on power transmission. **—K-53**

KEEP INFORMED

BUSINESS NOTES — NEW EQUIPMENT — LATEST CATALOGS

Liquefied-Gas Storage

"Refrigerated Storage Facilities," an eight-page brochure published by Chicago Bridge & Iron Co., describes the design and function of facilities for the storage of liquefied gases between +32 and −50 F.

The brochure points up economy and safety as well as other inherent features of low-temperature storage. Illustrations include vessels now in service and cutaway drawings of vessel types with descriptions of refrigerating systems. —K-54

Machine Tools

A newly revised 52-page catalog, describes the complete line of Walker-Turner light-heavyweight machine tools and accessories. Issued by Rockwell Mfg. Co. Walker-Turner Div., it describes drill presses, grinders, cut-off machines, band saws, and belt-and-disk surfacers. Complete specifications, catalog listings, and descriptions of accessories for all tools are also included.

The recently introduced 20-in. Power-Feed drill press, 15-in. drill press with 4 5/16-in. spindle travel, 14-in. Hi-Speed drill press and belt and disk finishing machine, top a list of new tools designed to broaden production-line applications. —K-55

Ball Valve

The new Lunkenheimer ball valve is described and detailed in two-page Circular 611 issued by the Lunkenheimer Co. The operation of the valve is detailed and ratings, specific design features, and dimensions are described with reports on applications and advantages. —K-56

Centrifugal Pump

The AJV line of vertical two stage split-case pumps recently announced by Aurora Pump Div., the New York Air Brake Co. is described in a new bulletin. These new vertical base-mounted pumps retain the proven-performance features of the Type AJ horizontal split-case line. Exclusive features provide streamlined liquid flow, hydraulic and dynamic balance, and maximum ease of maintenance or inspection without disturbing the suction or discharge-piping connections. Capacities range to 1400 gpm and heads to 425 ft. —K-57

Back-Up Rings

A 12-page booklet of design, dimensions, and other data on Parbaks, Parker Seal Company's continuous and contoured back-up rings, is now available.

This new booklet describes their characteristics and discusses the advantages of contoured and continuous rings. Complete dimensions and operating-media data are also included. —K-58

WHEN YOU NEED HELP IN A HURRY—

Koppers coupling service cuts costly down-time

Not every coupling service need is an emergency. But it's the emergencies that really test a good organization. That's why Koppers maintains experienced field engineers and outstanding stock facilities throughout the country. In addition, if it's a Fast's Coupling you're replacing, we have a serial number and specific application history for every Fast's for easy reordering. And our modern manufacturing facilities have the extra capacity to lick an emergency for special requirements.

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Isolator

A high degree of shock and vibration protection is provided for avionic equipment by the miniature "LO" isolator, Series L 21 and L 22, described in data bulletin No. 60-07 issued by Barry Controls Inc.

Weighing less than 1/2 oz and available in seven load ranges from 0.38 to 4.0 lb per mount, the isolator has low transmissibility—amplification of input is below 2.5 with 0.080-in. double amplitude. It can operate from −67 to +250 F without significant changes in isolation characteristics. Meeting the demands of MIL-C-172C by a wide margin, it has a number of other desirable features. —K-59

Ballizing

The ballizing process for high-speed, low-cost hole sizing and finishing is described in a 12-page technical Bulletin B 46, issued by Industrial Tectonics, Inc. A precision ball is pressed through the unfinished hole, and brings holes accurately to size with low-microinch finish faster than any other method.

The conditions best suited to ballizing, production and cost advantages, and production setups ranging from hand ballizing to fully-automatic machines are described. One section covers balls of tungsten carbide and chrome alloy steel for ballizing holes of any standard or special size from 0.020 to 5-in. ID. —K-60

Removing Contaminants

"Selas Micro-Processing Equipment," Bulletin MP-1, presents precision-built units for removing solid, liquid, or vapor contaminants from fluid systems in steel and metal-fabrication plants, pneumatic-instrument plants, for users of pneumatic instruments and tools, and in air-separation plants. Micro-porous materials remove contaminants in micron size and small quantities from the systems it is designed for.

Available from Selas Corp. of America. —K-61

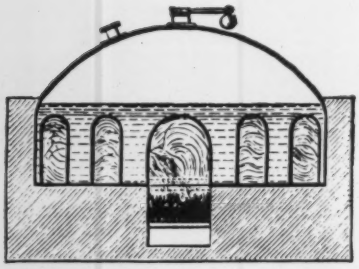
Power Supply

Sorensen & Co., a subsidiary of Raytheon Co. announces a 32-page handbook and catalog, giving tabular specification data on the company's complete line of more than 400 separate power-supply models.

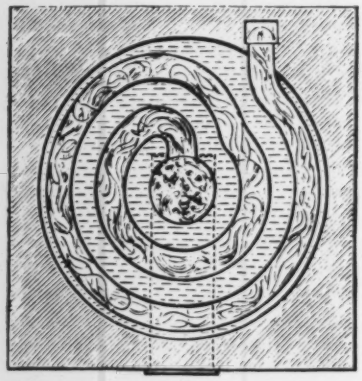
Included are regulated d-c supplies; frequency changers (variable-frequency power sources) high-voltage power supplies (to 600 kv) and other high-voltage products; miniature transistorized power supplies, inverters, and converters; and a-c line-voltage regulators. —K-62

Motors and Reducers

Sterling Slo-Speed gear motors and Slo-Speed separate motor reducers are described in an eight-page bulletin, No. 198, issued by Sterling Electric Motors, Inc., It illustrates the basic types and many modifications, as well as the universal mounting positions in which these units may be used. —K-63



CROSS-SECTIONAL VIEW—SIDE

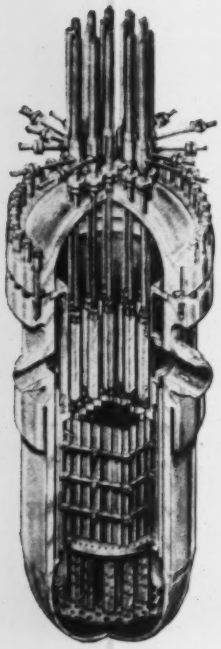


CROSS-SECTIONAL VIEW—TOP

AN ENGINEERING FRONTIER IN 1780 . . .

No known record exists today naming the inventor of this cylindrical boiler with a spiral flue used in 1780, but the design indicates a mind willing to push beyond accepted practices of his day. Flame entered the center of the boiler and moved through a spiral flue to the chimney. This relatively long traverse of the flame permitted the water to absorb a great deal of the heat, improving the efficiency of this early steam generating system.

AN ENGINEERING FRONTIER IN 1961 . . .



. . . is the development of commercial nuclear power utilizing such modern reactors as the Combustion Engineering design illustrated. Nuclear reactor systems capable of generating economical steam power for commercial use have long been an engineering goal in the American power industry.

Combustion Engineering, recognized internationally as a pioneer in the fast-moving technology of steam power generation, has developed in its Nuclear Division the engineering capability necessary to the successful pursuit of this goal. All of the elements essential to the design and development of well-balanced, high-performance reactor systems are under constant investigation by individuals skilled in the fields of engineering, physics, metallurgy, ceramics and chemistry. Staff positions are now available to individuals qualified in these disciplines.

During 1960, more than 35 C-E steam generating units with a total capacity of over 5 million kilowatts were installed in utility power stations in this country and abroad. The generation of commercial nuclear power is a natural extension of our product line.

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Mr. R. M. Killelea, Manager,
Professional Recruiting, Nuclear Division,
Combustion Engineering, Inc.,
Windsor, Connecticut

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COMBUSTION ENGINEERING, INC.

KEEP INFORMED

BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Electrical Products

A four-page bulletin, No. B81, on Joy electrical connectors, receptacles, switches, and lighting products for industry has been published by Joy Mfg. Co., Electrical Products Div.

Included are specifications and suggested applications for standard and custom-built electrical connectors. Also featured are general descriptions of lighting products, including lamps, sockets, and connectors, information on pushbutton switches in 2, 4, and 6-button and toggle-switch styles, and cable vulcanizers, both stationary and portable types. —K-64

Protective Coatings

The solution to a wide variety of corrosion and deterioration problems is presented in eight-page Bulletin T-97-61 on Bitumastic cold-applied protective coatings made by Koppers Co., Tar Products Div.

The coatings, which are applied cold by brush, spray, and roller, are each designed to meet specific problems—underground corrosion, water exposure, corrosive atmospheres, chemical and mechanical destruction of steel, and so forth.

Also available are three of a scheduled series of 11 brochures on specific coatings; Pamphlet T-197-1 on Bitumastic 11-S inhibitive primer, recommended especially for application in severely contaminated industrial and marine atmospheres; Pamphlet T-197-2 on Bituplastic No. 33, a "modified coal-tar emulsion coating" for multipurpose protection; Pamphlet T-197-3 on Bituplastic No. 44, a heavy-bodied emulsion material which combines coal-tar protection with superior adhesive properties. —K-65

Process-Industries Equipment

Equipment for the process industries is described in a comprehensive 12-page bulletin offered by the Fuller Co., a subsidiary of the General American Transportation Corp.

The new bulletin, G-3D, discusses applications and performance characteristics of Fuller-Kinyon pumps, Airveyor pneumatic conveyers, Fuller-Huron Airslide fluidizing conveyers, rotary compressors and vacuum pumps, horizontal-grate coolers, Fuller-Humboldt suspension-type preheaters, Sutorbilt positive-displacement blowers and gas pumps, and Lehigh induced-draft fans. —K-66

Presses and Shears

A 24-page condensed catalog describes Verson Allsteel Press Co. mechanical and hydraulic presses and press brakes, hydraulic shears, press and press-brake tooling, and special machinery. Basic specifications are given for the most commonly used Verson presses and press brakes. —K-67

Time has brought decisive progress in the fight against cancer. Ten years ago one in four persons with cancer was saved. Today it's one in three. But time alone will not conquer cancer. Time plus research will. And research needs your dollars. Send your contribution today to "Cancer," c/o your local post office.

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KEEP INFORMED

BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Castable Refractory

H. K. Porter Co., Refractories Div., has issued product literature on Firmcast, a hydraulic castable refractory for use to 2400 F. It has applications in soaking-pit bottoms, blast furnaces, stacks, boiler piers, rotary kilns, dutch ovens, aluminum furnaces, and many other metallurgical and nonmetallurgical furnaces.

The literature defines Firmcast, shows where it may be used, user's benefits, shipping details, ultimate-strength data, chemical analysis, physical properties, installation data, and information on where to purchase. **—K-68**

Turret Drill

The new Cincinnati Lathe and Tool Co. Cintimatic turret drill is described in an eight-page catalog. The six-turret numerically controlled machine, providing completely automatic drilling for a wide range of work, is designed to afford remarkably quick and simple setup with minimal jig and fixture requirements.

In addition to work-table positioning, the Acramatic console controls tool selection, feed, spindle speed, hole depth, and tapping cycle. Setup is further simplified by a tool-length compensator which adjusts for work height and tool length. **—K-69**

Photoelectric Control

An eight-page bulletin is available containing information about Infrabeam an infrared photoelectric control made by Cramer Controls Corp., Electronics Div., which functions by reflected or interrupted beam over an extremely long range, even under high-general-light conditions. Typical materials-handling, counting, inspection, and control installations are illustrated, together with detailed specifications and descriptions of models and accessories. **—K-70**

Cast-Tooth Sprockets

Stock sizes of cast-tooth sprockets, available for immediate delivery in every major industrial area, are conveniently listed in a 12-page book, No. 2867, released by Link-Belt Co. Cast-tooth sprocket teeth are ground to fit the chain. There are 132 different chain numbers listed and cross referenced to 48 sprocket lists. The complete range of types and sizes, considering all permutations, permits selection from over 30,000 sprockets in stock.

Basic types include arm-center, plate-center, segmental, and split-rim sprockets and traction wheels. Available materials include Flint-Rim—a chilled cast, wear-resistant tooth surface; gray iron; cast steel; stainless; aluminum; and many other metals and alloys. **—K-71**

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says
AIR CARGO EQUIPMENT CO.
at Glendale, Calif.

Our use of LUBRIPLATE Lubricants exclusively, followed the "torture testing" of our Bulldog Cargo Winch at an Air Force test center. The 196 pound winch, lubricated with LUBRIPLATE, was operated under a six ton load in environments of extreme heat, cold, salt, humidity, dust, altitude, explosive vapor and pressure. Now, our unconditional guarantee is valid only if the LUBRIPLATE Lubricants, factory sealed in our winches, are not replaced by other lubricants.

John J. Terlep, Sales Manager

REGARDLESS OF THE SIZE AND TYPE OF YOUR MACHINERY, LUBRIPLATE GREASE AND FLUID TYPE LUBRICANTS WILL IMPROVE ITS OPERATION AND REDUCE MAINTENANCE COSTS.

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KEEP INFORMED

NEW EQUIPMENT BUSINESS NOTES LATEST CATALOGS

Stopwatch-Selection Guide

A 16-page stopwatch-selection guide describing a complete line of precision timing instruments for all segments of industry, including production analysts, engineers, and others in design, testing, and control has been announced by Heuer Timer Corp.

Complete data and specifications on construction, method of operation, size, and reading are given for over 100 different timers. —K-72

Soot Blowers

Three bulletins describe Vulcan rotary soot blowers made by Blaw-Knox Co., Copes-Vulcan Div. Bulletin 1067 covers the air-powered Model D-4-A, 1071 the manually operated D-4, and 1072 the electric D-4-E.

Each of the four-page bulletins has external and sectional views of the soot blowers, as well as diagrams illustrating the simple three-step procedure for removing the soot-blower head and element from the boiler. —K-73

Electric Plants

One to eight-cylinder gasoline and diesel-driven electric plants that are highly portable, moderately priced units are described in a four-page bulletin issued by D. W. Onan & Sons, Inc. A number of one and two-cylinder models are air-cooled and provide 500 to 10,000-watt a-c or 500 to 3000-watt d-c output. Water-cooled four, six, or eight-cylinder gasoline units provide 10,000 to 170,000 watts a-c; and three, four, and six-cylinder diesel-driven units provide 10 to 230,000 watts a-c. —K-74

Vertical Compressor Package

Bury Compressor Co., has just released a factual catalog, No. V-100, describing its complete line of vertical package compressors. These are standardized for 125 psi in sizes 50 to 2000 h.p. Model VS covers packaged compressors to 973 cfm for belt or direct drive. Model VE covers packaged units to 13,400 cfm for direct drive. Write for Catalog V-100 —K-75

Refractory Fiber Insulation

Cerafelt, a lightweight refractory fiber insulation is described in product-information sheet IN-283A available from Johns-Manville Corp. which contains complete information on the material, which combines lightness, heat resistance, low conductivity, and high sound-absorption qualities. The 2000-F temperature-limit material can be used for repairing of open-hearth roofs, on cover-type annealers to fill electrical-access openings, and for expansion joints in kilns, furnaces, and boiler walls. —K-76

Teflon Hose Assemblies

Bulletin TC-46 issued by Anaconda Metal Hose Div., the American Brass Co., describes Type T4 hose and reusable fittings that can be made up into assemblies on the job with ordinary hand tools. T4 hose is a flexible hose with a core of Teflon and stainless-steel wire braiding. The hose conveys steam, fuel, lubricants, hydraulic fluids, chemicals, and similar materials. Construction, properties, full engineering data, and assembly instructions are given. —K-77

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. . . when some stuck together part threatens production. They won't take a chance on breaking the part with brute strength.

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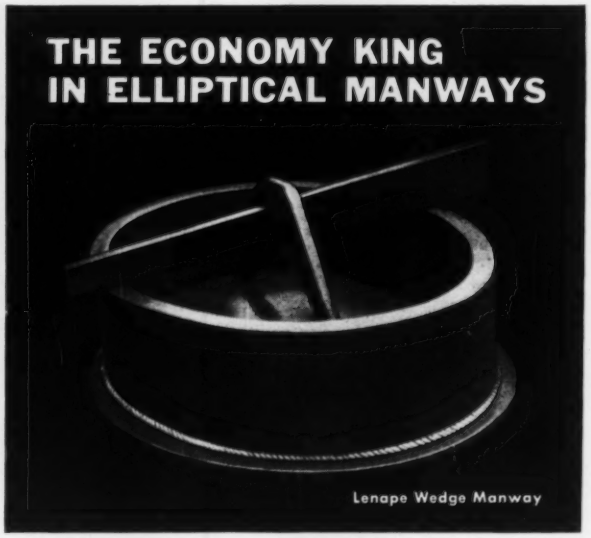

Tap in the wedge . . . it's sealed. Tap out the wedge . . . it's open. That's all there is to the unique Lenape WEDGE MANWAY *. Troublesome, costly bolts and yokes are completely eliminated.

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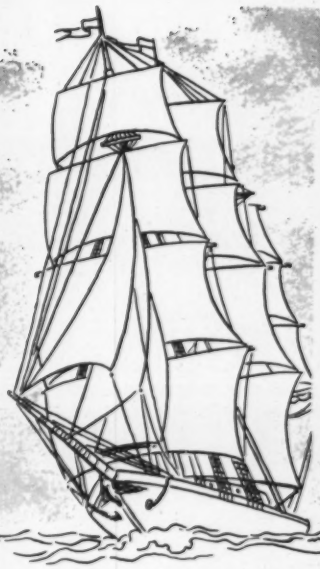
and what this difference, backed by 35 years of industry proof, means to you!



A Sea Captain developed it . . . Industry proved it!

The original Rust-Oleum formula was developed nearly fifty years ago by Sea Captain Robert Fergusson, who became intrigued with the rust-stopping qualities of fish oil early in his career. Creating a *special treatment* for the fish oil, he used the *specially-processed fish oil* as the vehicle in combination with fine rust-inhibiting pigments. The result? A coating that actually *stopped rust* when applied directly over sound rusted surfaces, after scraping and wirebrushing to remove rust scale and loose rust. Possible, because the *specially-processed* fish oil penetrated the rust to bare metal. This was the birth of Rust-Oleum's *exclusive* 769 Damp-Proof Red Primer.

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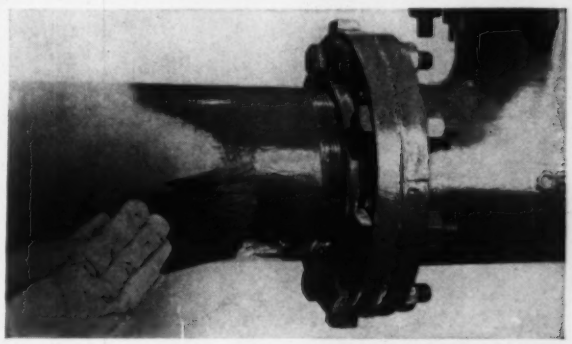
The Rust-Oleum New Color Horizons System introduces a new coating concept to industry. It combines four important factors: (1) the ability to stop rust, (2) smart, modern color harmony, (3) the durability to last and last, (4) ease of application that saves time, money, and metal. See how this system can bring lasting beauty to your plant, machinery, equipment, pipes, tanks, structural steel, fences, etc. Write for complete information or contact your nearby Rust-Oleum Industrial Distributor. He maintains complete stocks for prompt service.



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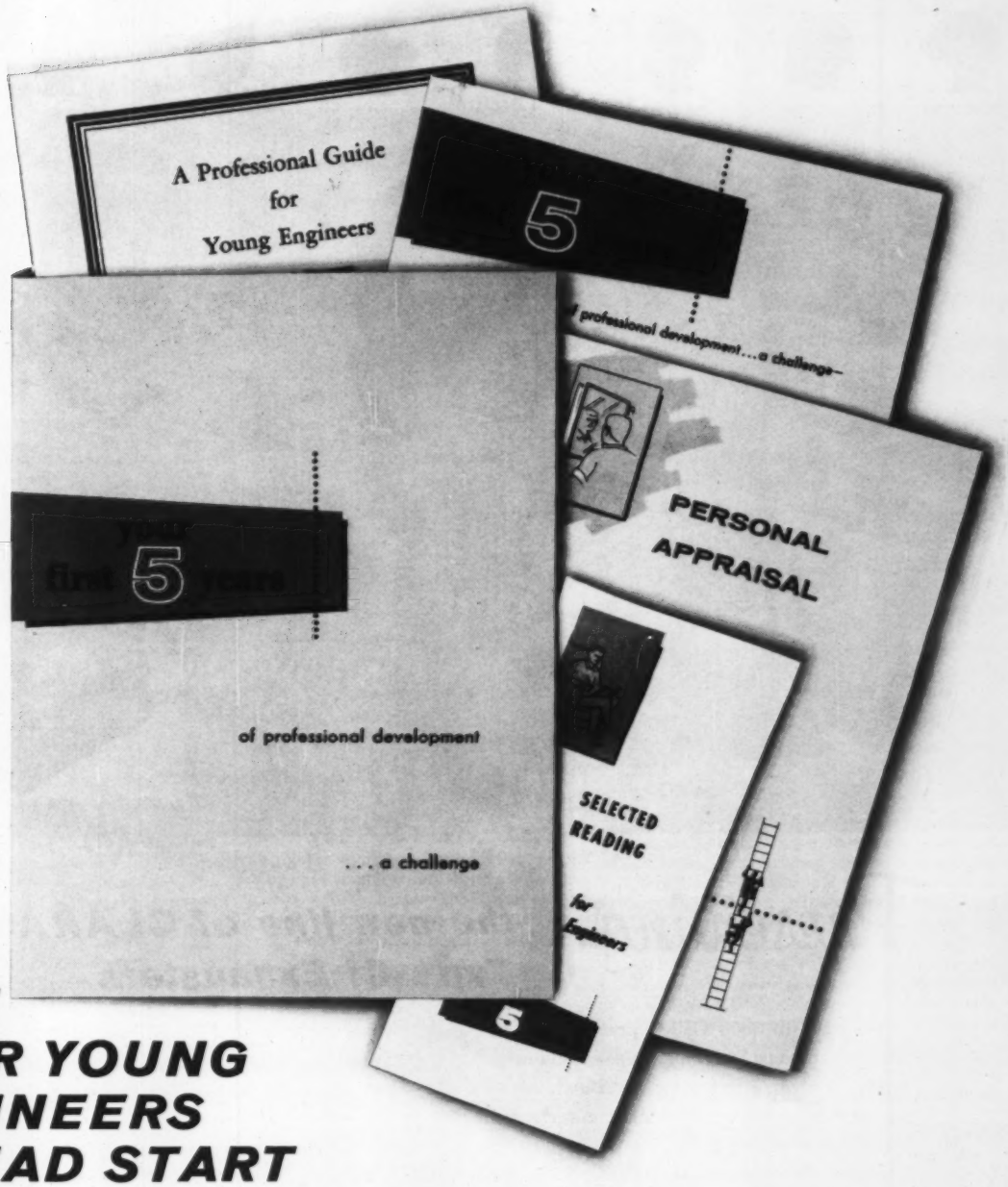

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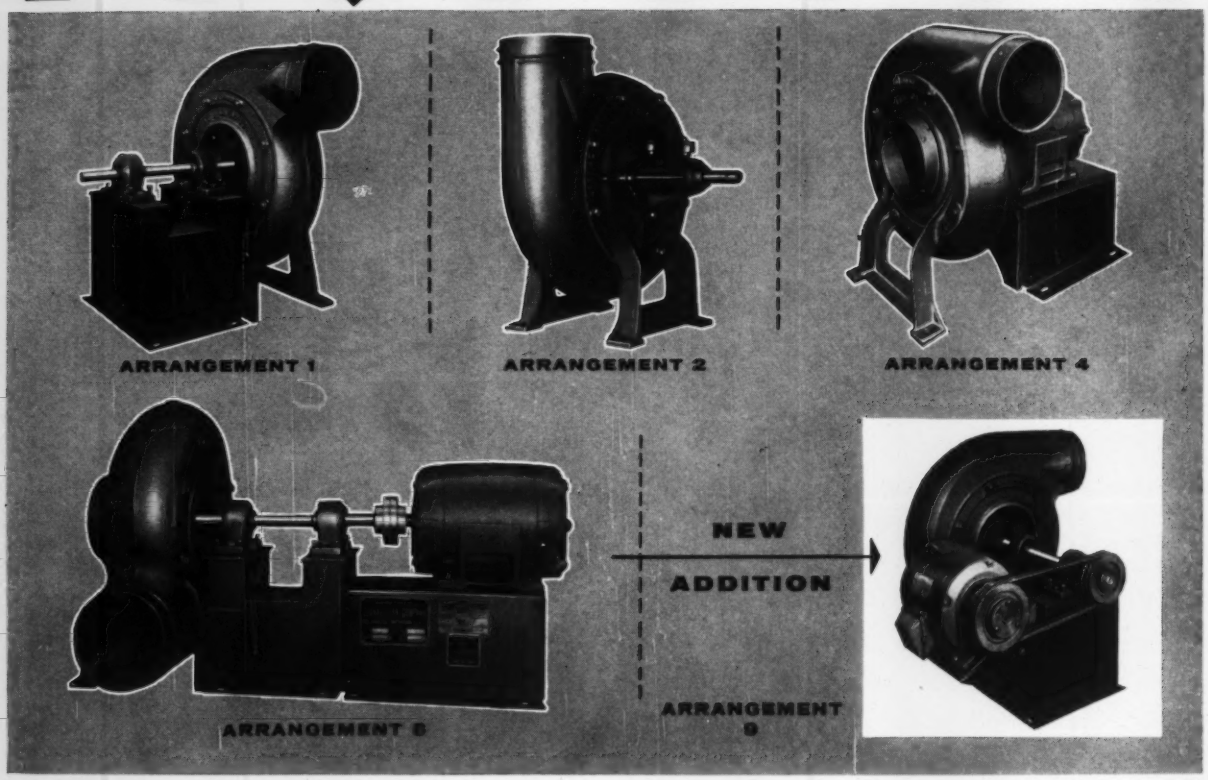

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Some Ideas

for your file of practical information on drafting and reproduction from

KEUFFEL & ESSER CO.

Six years ago, K&E introduced the very first polyester-base drafting film—a special-purpose medium featuring extreme dimensional stability. Experience with that film indicated that a definite need also existed for a *general-purpose* drafting film, if one could be perfected. About two and a half years ago we succeeded, introducing HERCULENE® Drafting Film – the first polyester-base medium for general drafting to meet professional standards. Many recognized its value immediately, stocked up on HERCULENE, and have used it happily ever since. Others – a bit more "canny" about adopting a relatively untried medium – deferred decision, saying "see us in a year or so." Still others – having tried one or more of the other films marketed immediately after HERCULENE – seemed permanently disenchanted with *all* film based media. What with the passage of time and much favorable ado about drafting films in general, we rather think that those once stung may now have adopted a more congenial attitude – so we address ourselves solely:

To fence-sitters everywhere . . .

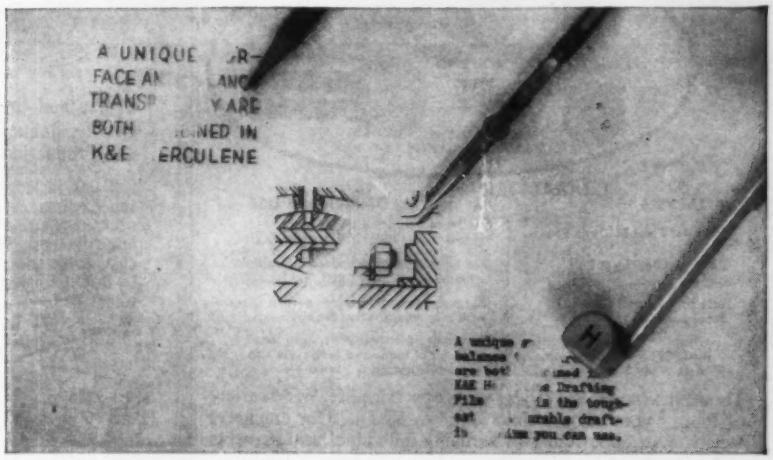
Just as we felt in '58, we feel today, that film has an important place in the drafting room. The only difference now is that experience has *proved* it so. Since 1958, the number of HERCULENE users has grown by leaps and bounds. All, we're happy to say, have found HERCULENE a welcome, efficient, and *much needed* addition to their stock of drafting media. It is these HERCULENE users who have written the record. Their many and rigorous tests, their months of experience, their numerous successes and continuing satisfaction are convincing evidence that HERCULENE is all we said it would be.

Why all the fuss about HERCULENE? . . .

HERCULENE combines practically all the qualities of a perfect drafting medium. An excellent product when introduced, it's even closer to perfection today. Working with major film users, K&E specialists have refined HERCULENE in many subtle ways since its introduction.

Unlike cloth or paper, HERCULENE is virtually indestructible. No matter how roughly or frequently a HERCULENE tracing is handled, it will never crack, wrinkle or fade. Absolutely waterproof, a HERCULENE drawing can never be permeated and ruined by moisture. Filed away, HERCULENE will last indefinitely. And HERCULENE has body, too, making it far easier to handle and file, and to keep flat on the drawing board.

Most of the refinements made in HERCULENE since 1958 have concerned its engineered drafting surface. HERCULENE's surface "take" for pencil, ink and typing is now better than ever. Erasability, of course, is excellent for all three. Contrast has been built up for sharper definition of line, too, yet all the transparency necessary for fast, clear reproductions has been maintained.



Two big bonuses, too . . .

A significant chapter in the HERCULENE story has been the development of a waterproof writing mate – the Duralar plastic pencil. Drawings made on HERCULENE with this waterproof pencil can actually be

washed in soap and water. Even gray, grimy "unreproducible" drawings can be washed spotless with this new technique. Many firms now use the HERCULENE/Duralar team exclusively . . . and are realizing undreamt-of savings in costly re-draws.

Some firms, of course, by virtue of smaller work volumes and "cleaner" or less frequent handling, will have little need for this new wash technique. Of particular interest here is another K&E exclusive recently introduced – the amazing Ruwe pencil. The Ruwe pencil will not withstand washing, but in every other respect, this new pencil is graphite-*plus*. Although of plastic composition, the Ruwe pencil has all the "fine" feel of graphite, erases well, and deposits a sharp, dense black line. The big bonus: Ruwe pencil lines are *virtually smudge-proof*. Rendered on HERCULENE's engineered drafting surface, they actually resist smudging better than graphite on regular paper!

We leave it to you . . .

The best test remains the one you make for yourself. We've just completed a new brochure, titled "A Report on the Growing Acceptance of Polyester Film." In it is detailed most of what we have learned about HERCULENE and its use since 1958 – including tests you can make to assess its every property. We'd like you to have a copy of this new brochure – plus a sample sheet of HERCULENE, a Duralar pencil, and a Ruwe pencil – for your own private testing. To get these free samples, simply fill out and mail the coupon below:

KEUFFEL & ESSER CO., Dept. ME-1, Hoboken, N. J.

Gentlemen:

Please send me your new brochure, titled "A Report on the Growing Acceptance of Polyester Film," a sample sheet of HERCULENE Drafting Film, and samples of the Ruwe and Duralar Pencils.

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Company & Address _____

_____ 4031

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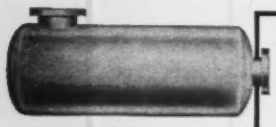

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Full line includes 14 units in various sizes, capacities for your needs, any size area. Units have low first cost, low operating cost, automatic controls. Easy to install from ceilings or on walls.

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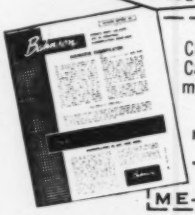

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ME-2-J WINSTON-SALEM, N. C., U. S. A.

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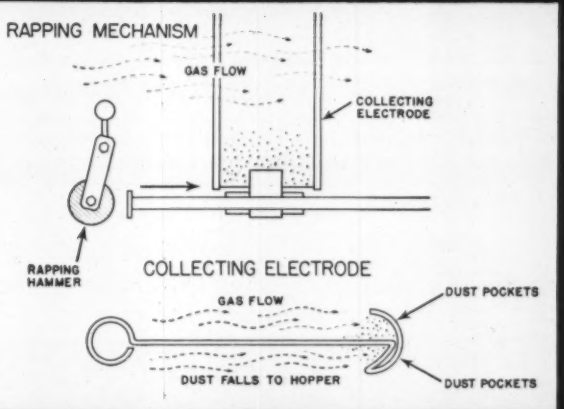
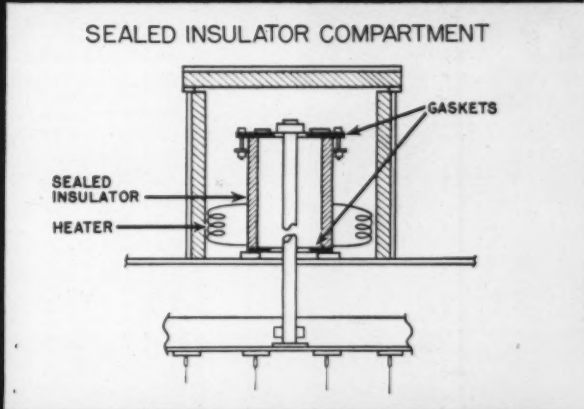
Copies of this List are obtainable from
THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS
Publication-Sales Dept.
29 West 39th St., New York 18, N. Y.

SOME PLAIN FACTS

ABOUT SUPERIOR PRECIPITATOR PERFORMANCE

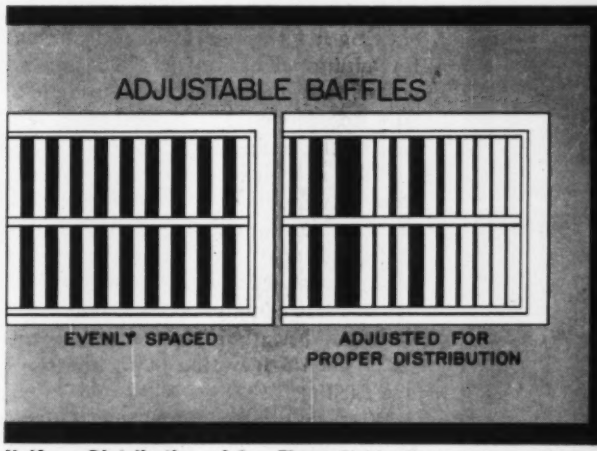
Buell Precipitators are designed and constructed for rugged service and superior performance. Frills and internal frim-fram of a doubtful value are eliminated in favor of strength and simplicity. The casing, outside supports, and internal parts are of rugged construction; and the four-point suspension of emitting electrodes ensures the greatest stability. Here are just a few of the outstanding features of Buell Precipitators.





Effective Continuous Cycle Rapping—Yes, it's mechanical. A simple, rugged system free of complicated gadgets; assures positive dust shearing action. Each row of electrodes is rapped separately—in the direction of the gas flow—on a continuous cycle. Dust is sheared off, drops in an agglomerated mass and pockets on electrodes minimize reentrainment.

Sealed Insulators Improves Operation—High voltage quartz support insulators are completely sealed; prevents gas and dust leaking into insulator compartment and outside air leaking into precipitator. There is no need for costly ventilating systems. Thermostatically controlled electric heaters insure start-up without danger of moisture condensation and insulator breakdown.



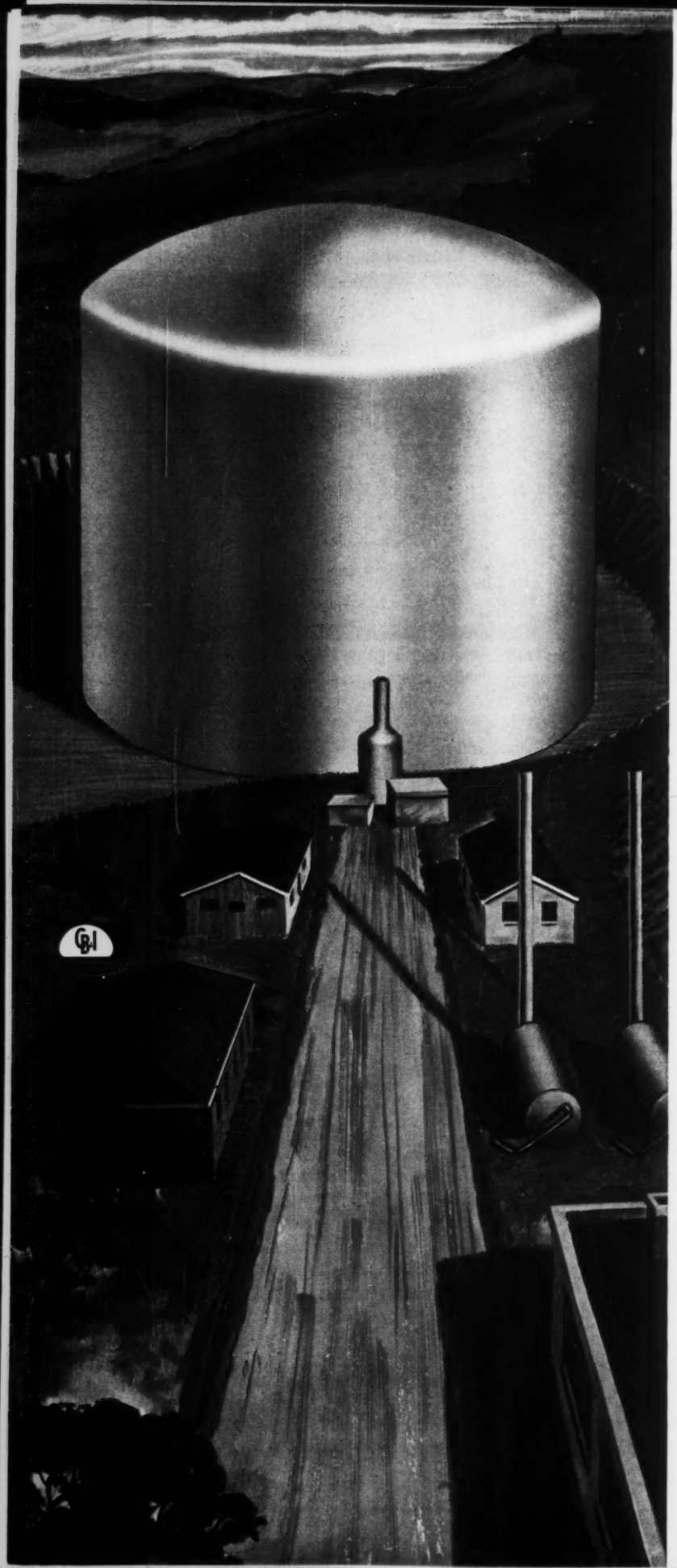
Uniform Distribution of Gas Flow—Field adjustment capability is vital. Buell's adjustable baffle permits final positioning after field measurement of actual flow distribution . . . because gas flow patterns are not entirely predictable. The Buell distribution system assures equal gas loading through the precipitator; eliminates ineffective "dead" areas around passages and prevents "sneak-by."

Buell Spiralectrodes cut maintenance to a minimum. Buell's record stands at less than 1% replacement in this key area. Self-tensioned spiralectrodes eliminate vibration and "off-center" swaying, often prevalent with weight-tensioned wires. They're structurally fixed and once installed stay in alignment. The spiralectrode provides greater emission than straight wires.

Buell precipitators are simple and effective. They're designed for continuous service. You'll be glad you turned to Buell when you experience superior performance and low maintenance. Detailed literature describing all features is available.

buell Norblo

The Buell Engineering Co., Inc., Dept. 58-A, 123 William Street, New York 38, N. Y. Northern Blower Division, 6421 Barberton Avenue., Cleveland, Ohio.
■Electric Precipitators ■Cyclones ■Bag Collectors ■Combination Systems ■Fans ■Classifiers.



Unique Refrigerated **PROPANE** Storage System

WILL REDUCE COSTS OF DOUBLING PEAK SHAVING CAPACITY

A 120,000 bbl. propane storage tank will be the heart of a refrigerated facility for liquefied gas under construction at Minneapolis Gas Company.

The facility employs a unique approach in self refrigeration. Purging and control problems are reduced by condensation of vapors at less than ambient temperatures.

The double wall steel tank stores 120,000 bbls. at −50°F, the equivalent of 137,500 bbls. at +60°F. The outer tank will be 106 feet in diameter and 100 feet high.

Storing propane as a liquid for peak shaving is less costly than contracting for additional natural gas. The initial cost of conventional above-ground pressure storage would be about 3 times the cost of this refrigerated facility.

Fully refrigerated storage was selected for the new facility for (1) economy, (2) ease of expansion and (3) the ability to locate the facilities exactly where they would do the most good.

CB&I has complete responsibility for design, fabrication, erection and start up of the refrigeration plant and storage facility.

Write for our Brochure G-48, "Refrigerated Storage Facilities."

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OPPORTUNITIES

positions open • positions wanted • equipment, material, patents, books, instruments, etc. wanted and for sale • representatives • sales agencies • business for sale • partnership • capital • manufacturing facilities

ANSWERS to box number advertisements should be addressed to given box number, care of "Mechanical Engineering," 29 West 39th St., New York 18, N. Y.

RATES: Classified advertisements under this heading in MECHANICAL ENGINEERING are inserted at the rate of $4.50 a line. $2.00 a line to members of ASME. Seven words to the line average. A box number address counts as one line. Minimum insertion charge, 5 lines. Display advertisements carried in single column units of multiples of one inch at flat rate of $45.00 per inch per insertion. Copy must reach us not later than the 10th of the month preceding date of publication.

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DEVELOPMENT AND SALES ENGINEERS

VALVES and mechanisms for critical high-pressure, high-temperature services in the growing marine, petroleum, process and power fields—including nuclear power.

CONTACT J. M. Evan, Edward Valves, Inc., subsidiary of Rockwell Manufacturing Company, 1200 W. 145th St., East Chicago, Indiana.

AIR POLLUTION ENGINEER

Vacancy with the State of Hawaii Department of Health, Bureau of Industrial Hygiene. Requires one year of work experience in the design, construction, or alteration of fuel-burning equipment and a bachelor's degree in mechanical, chemical, sanitary or civil engineering. Appointments to this position may be made at any step between $6,792 to $8,664 per annum. For further information and application, write to the Department of Personnel Services, State of Hawaii, 825 Mililani St., Honolulu 13, Hawaii.

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B.S. or Advanced Degree in Mechanical Engineering for Die Design and Development

Challenging opportunity for research. Oriented engineers with considerable experience in the field of die design. Position requires a high degree of technical competence in analytical and experimental research in die design for containers and container components.

Good Growth potential, outstanding benefits, and salary commensurate with ability, education and experience.

Apply by submitting resume. Address CA-7092, care of "Mechanical Engineering."

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Picatinny Arsenal is an important Army Ordnance Research and Engineering center. It is engaged in continuous research and development as well as industrial and maintenance engineering activities in the field of ammunition and missiles.

We are particularly interested in graduate engineers and scientists with backgrounds in:

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Development and Design
•
Production Engineering

For work on intricate ammunition items and components for guided missiles and nuclear weapons.

These positions are in the Career Civil Service.

Send resume including salary requirements to:

Civilian Personnel Office
Picatinny Arsenal
Dover, New Jersey

ENGINEERS MECHANICAL – ELECTRICAL

Challenging opportunities in the design and development of Industrial Automation Equipment are available at Aerojet General Corpostation Atlantic Division. Positions offer unusual professional scope for the inventive, imaginative engineer who wishes to become established in a progressive organization with many employee benefits. B.S. degree and 2 to 7 years' experience required.

Relocation allowances cover moving costs plus transportation reimbursement for you and members of your family. Personal interviews will be arranged for qualified candidates. Send confidential resume including present and required starting salary to Mr. Virgil Hylton, Personnel Manager at: AEROJET-GENERAL CORPORATION Atlantic Division, P. O. Box 460, Frederick, Maryland.

Wanted Electrical, Mechanical or Chemical Engineering graduates to be trained as Sales Engineers for our Chicago and Cleveland districts. Prefer men between 25 and 32 years of age who have had industrial process experience. Successful applicants will be given a three-month factory course starting February 1, 1961. Write Harry E. Beane, Vice President, The Bristol Company, Waterbury 20, Connecticut.

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SOLID STATE PHYSICIST—Ph.D. or M.S. experience with electronic devices used in automatic control systems.

Above personnel will develop and guide research programs, interpret results and consult on advanced engineering problems. Digital and analog computers available. Excellent library facilities. Write in confidence to Personnel Manager:

BABCOCK & WILCOX RESEARCH CENTER
Alliance, Ohio

It will pay you to read the announcements on these pages for an opportunity that you may be looking for or one that may be of interest to you.

"BREATHING SYSTEM" for the 2,000 mph B-70

. . . PRESENTS A.S.M.E. MEMBERS WITH UNIQUE ENGINEERING CHALLENGES. B.S. SENIORS AND M.S. AND PH.D. CANDIDATES WILL FIND SUCH UNDERTAKINGS TYPICAL AT HAMILTON STANDARD.

Development of the air-induction control system for the B-70 bomber is a realistic portrayal of Hamilton Standard's engineering capabilities. The aircraft will fly at speeds from 300 to 2,000 mph . . . altitudes from sea level to 70,000 feet. The air induction control system not only senses the pressure and temperature of the engine inlet air flow, but automatically monitors and regulates the air to the plane's six engines. Development of the system is a demanding engineering task. Equally demanding is the B-70's environmental conditioning system which is also under development at Hamilton Standard.

While we cannot detail all of Hamilton Standard's product areas, there are stimulating assignments available in the broad fields of missiles and space systems, electron beam technology, electronics, ground support equipment, solar power generation and others. It is a company which is entering its most exciting era of growth and accomplishment . . . and can offer young men unusual engineering opportunities.

Add to the above, the attractive living conditions of beautiful Connecticut . . . one of the industry's finest company-paid graduate programs . . . the extensive facilities of United Aircraft Corporation . . . and you can appreciate why so many of your fellow A.S.M.E. members have found rewarding careers at Hamilton Standard.

For complete information and the brochure, "Engineering For You and Your Future", write Mr. R. J. Harding

HAMILTON STANDARD DIVISION

an organization dedicated to Scientific and Engineering Excellence

UNITED AIRCRAFT CORPORATION

WINDSOR LOCKS, CONNECTICUT

MECHANICAL ENGINEERS

Bausch & Lomb

There are several openings for Senior Design Engineers in the Product Design sections of our company.

These openings are permanent positions requiring the ability to take Mechanical Design responsibility from specifications to a saleable product. Products involved are mechanical-electrical-optical in nature. A Mechanical Engineering Degree and at least 6 years of mechanical design experience is required. No optical or electrical background is necessary, but would be helpful in certain openings.

These positions require board design, coordination of customer requirements with Electrical and Optical Designers, supervision of detail draftsmen, assistance to shop during construction and assembly as well as testing and development work.

Those who can qualify and are interested in real design responsibility are invited to submit a resume to: Mr. H. A. Frye, Professional Employment.

Bausch & Lomb

INCORPORATED

18 Bausch Street

Rochester 2, New York

IMPORTANT

PROGRESS TOWARD ADVANCED

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—THROUGH NUCLEAR POWER

—the flight vehicle which can live in the air as easily and confidently as a ship lives in the sea— will be powered by a nuclear reactor, the only source of energy which can provide virtually unlimited range and endurance for aircraft, for high altitude or on the deck, long range military air missions.

When the program to produce such a nuclear propulsion system was started at General Electric in May, 1951, experts then felt that the project might take twenty years.

But today, little more than nine years later, the Aircraft Nuclear Propulsion Department of General Electric has developed and demonstrated the basic technology required to build and fly a high performance aircraft nuclear propulsion system.

During the 9-year span of effort, General Electric engineers and scientists have achieved major breakthroughs in reactor technology, shielding techniques, high temperature resistant materials, specialized controls capable of functioning reliably in a high density radiation environment, and in other areas.

One of these technical achievements is discussed to the right in capsule article form. In succeeding announcements other interesting technical advances at the Aircraft Nuclear Propulsion Dept. of General Electric will be discussed.

ADVANCES IN NUCLEAR SHIELDING TECHNIQUES

As the shield is the largest weight item in the propulsion system, major effort has been applied to shield theory, experiment and design since the initiation of the Aircraft Nuclear Propulsion program.

The dimensions of the problem faced are evident when you consider that General Electric engineers had to find a way to reduce shielding weights from hundreds and thousands of tons for stationary nuclear power plants by orders of magnitude.

One of the major gains registered was the concept of the divided shield, i.e. dividing the shielding between the power plant and the crew compartment. This concept takes advantage of the fact that even the most sensitive component of the system can withstand 10,000 times the amount of nuclear radiation that a human being can tolerate.

This concept has been defined through the use of improved analytical techniques to produce detailed radiation patterns around reactor shield assemblies. New computer programs, and new calculation techniques developed at General Electric have yielded invaluable data for the design of sophisticated shielding configurations.

Additional improvements have been attained through study of materials. Materials not formerly employed for reactor use have been developed and applied. Design techniques have been created which take maximum advantage of these materials.

These theoretical and experimental investigations have resulted in shields which are so light that nuclear aircraft need be no heavier than present day airplanes. Shielding weight is no longer a critical problem.

Although much has been accomplished, further improvements in shielding technology are being developed through improved calculation methods, advanced materials development and more sophisticated structural design.

Opportunities exist today for Engineers and Scientists from many disciplines to contribute to precise solutions of a variety of sophisticated problems pertaining to the final development stage of General Electric's nuclear propulsion system for high performance aircraft.

Openings available in both Cincinnati, Ohio and Idaho Falls, Idaho for:

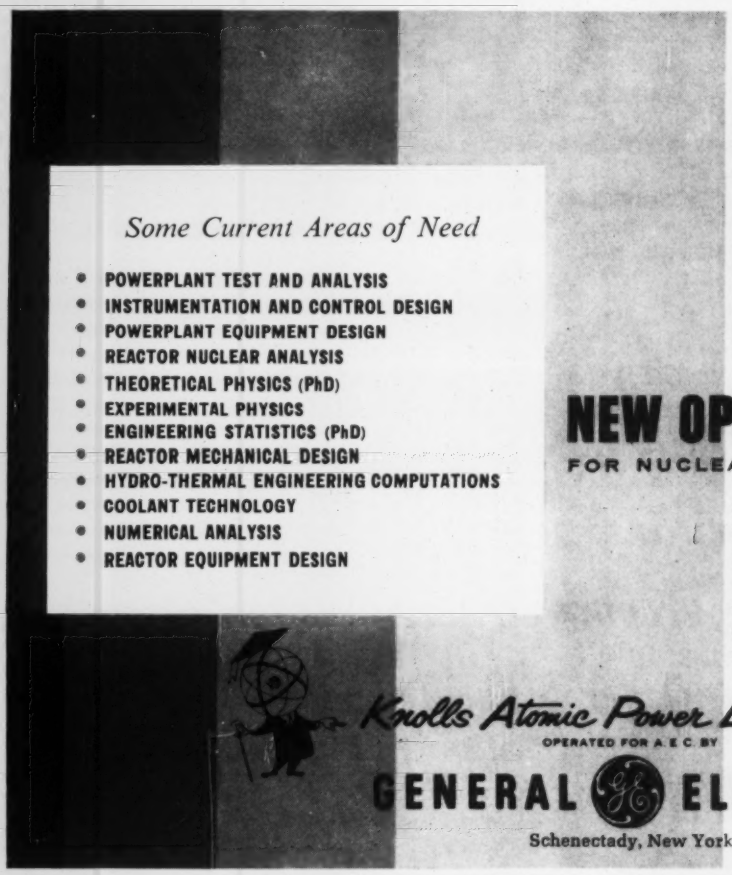
Metallurgists; Ceramists; Mathematicians; Technical Editors; Mechanical, Electrical, and Chemical Engineers; Nuclear and Solid State Physicists; Physical Chemists.

If you have an interest, and qualifications, in any of these areas, please write in confidence to: Mr. George Hunsinger, *Manager, Professional Personnel. Room 41-MA.*

AIRCRAFT NUCLEAR PROPULSION DEPARTMENT

GENERAL ELECTRIC

P.O. BOX 132 CINCINNATI 15, OHIO



Some Current Areas of Need

- **POWERPLANT TEST AND ANALYSIS**
- **INSTRUMENTATION AND CONTROL DESIGN**
- **POWERPLANT EQUIPMENT DESIGN**
- **REACTOR NUCLEAR ANALYSIS**
- **THEORETICAL PHYSICS (PhD)**
- **EXPERIMENTAL PHYSICS**
- **ENGINEERING STATISTICS (PhD)**
- **REACTOR MECHANICAL DESIGN**
- **HYDRO-THERMAL ENGINEERING COMPUTATIONS**
- **COOLANT TECHNOLOGY**
- **NUMERICAL ANALYSIS**
- **REACTOR EQUIPMENT DESIGN**

Building on a succession of achievements in reactor applications and nuclear development, The Knolls Atomic Power Laboratory is currently expanding its program scope in a number of new directions—both exploratory and developmental.

Security restrictions prevent the identification of projects, or a detailed disclosure of the unique professional opportunities now open at KAPL. However, within these limitations we would be pleased to discuss the unclassified portions of our programs and describe the Laboratory's specialized experimental, computational and test facilities to nuclear scientists and engineers interested in reactor power plant development.

NEW OPENINGS ANNOUNCED

FOR NUCLEAR ENGINEERS AND SCIENTISTS

Qualified candidates, with experience in one or more of the fields listed at the left are invited to inquire about positions now available.

Address your inquiry in strict professional confidence to Mr. A. J. Scipione, Dept. 41-MA. U. S. Citizenship and appropriate engineering or scientific degree required.

Knolls Atomic Power Laboratory

OPERATED FOR A. E. C. BY

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Schenectady, New York

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How can we design and develop products, intricate and simple equipment, carry out research at much lower cost than many manufacturers pay for this work? We are not engaging, on this project, engineers having 60 credits in basic engineering sciences and charge the costs against your products, of additional training of 100 credits in applied engineering sciences, including salaries during their training. Inasmuch as the major part of technical literature is available in English, German, Russian, our engineers must speak 2 of the 3 languages. They must have completed the two-year pre-engineering college study at high schools where this is standard, have devoted all their study at the college to the not less than 160 college credits in basic and applied engineering sciences, and must have taken minimum of 50 credits in the field of students specialization with teachers actively engaged for over 25 full years in research and design in the respective fields. They must have one year experience in machine shops, foundries, forges, on locomotives, ship engine rooms, chemical plants, etc. to supplement their text book knowledge of; manufacturing, processes, organization, etc. Starting salary for recent graduates, ME, EE, IE, ChE, PhD, Metallurgists, etc. $135 per month. Doctor engineers with 200 college credits in basic and applied engineering sciences and 20 years of research and design experiences $280 per month. The extensive engineering training is required to enable our engineers to approach analytically their problems to greater extent and reduce or eliminate costly time consuming experimentation.

Send your inquiries to:

A. Vincze, 58-31 219th St., Bayside 64, N. Y.

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BRUNSWICK CORPORATION is expanding its Research and Development Division and offers outstanding career opportunities for graduate Mechanical Engineers qualified to handle positions involving

- ***AUTOMATIC MACHINERY DESIGN***
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This is an opportunity to associate with a company recognized as a leader in the recreational field, and whose growth and stability has been outstanding. Positions offer good opportunities for technical advancement and long-range careers. Openings available at various levels from recent college graduates, Senior Design and Project Engineers to Engineers who have supervisory experience. New and modern engineering offices offer excellent work environment. The company is located in Western Michigan, "Heart of Michigan Vacationland" offering excellent opportunities for family recreational activities. Positions offer challenging work, attractive starting salaries commensurate with experience, along with excellent fringe benefits.

Send replies outlining education, experience, and salary desired, to A. J. Nelson.

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For employment write to: Personnel Director Division 61-6

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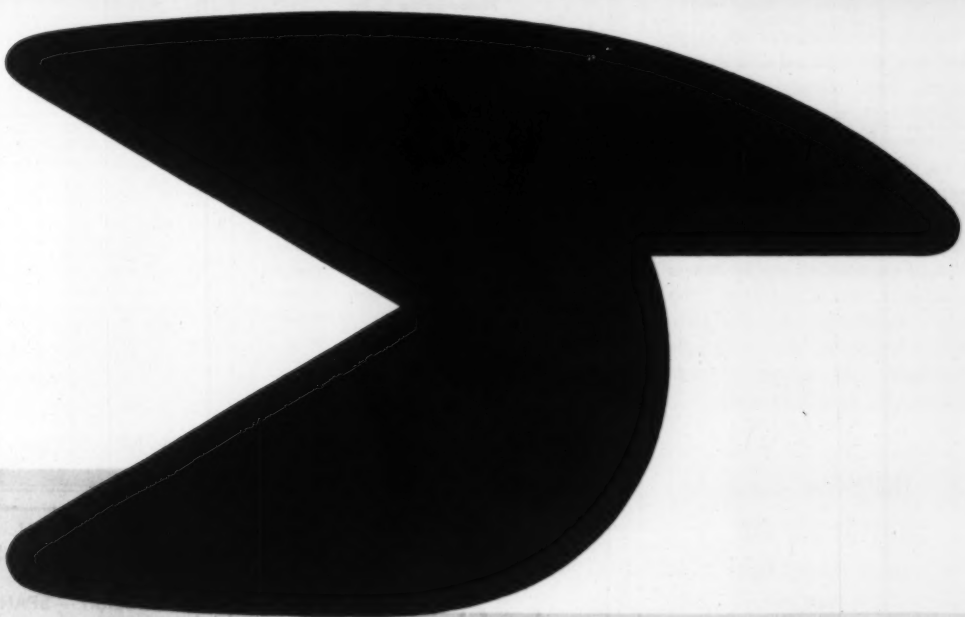

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ENERGY TECHNOLOGY At THOMPSON RAMO WOOLDRIDGE INC.

In the development of advanced energy technology, efforts at Thompson Ramo Wooldridge encompass energy conversion, regulation, inversion and control. Research and development is currently in progress on:

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- Thermionic Power
- Magnetohydrodynamic Power
- Electric Propulsion
- Integrated Environmental Control Systems
- Vehicle Atmospheric Control
- Closed Cycle Oxygen Regeneration

Selected assignments are available now in analytical and experimental heat transfer, fluid dynamics; liquid metal and gas bearing research, turbomachinery analysis, plasma physics and electrochemistry.

Scientists and engineers with unusual capabilities are invited to investigate positions at Thompson Ramo Wooldridge Inc. For additional information, write informally or forward your resume in confidence to Mr. James Panoska.

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Robert College, In Istanbul, Turkey, presents a challenge in education in a vital part of the world. West and Middle East are contributing side by side to the development of a young and vigorous nation. Opportunities are available in engineering, business administration and economics, the sciences, and the humanities. Graduate degrees required.

Address inquiries to **Dr. Howard P. Hall, Dean of Faculty, Robert College, Bebek Post Box 8, Istanbul, Turkey; with copy to the Near East College Association, 548 Fifth Avenue, New York 36, New York.**

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Large midwestern natural gas company will employ a graduate, professional engineer for this position. He must have at least 10-15 years' experience in compressor, process, and pipeline design. 3-5 years' fully responsible supervision of such work is required.

This is an excellent opportunity for rewarding work and personal development. Stock purchase, pension and other employee benefit plans are excellent. Age limit 45. Send your complete, detailed resume, including salary requirements. Address CA-7070, care of "Mechanical Engineering."

MECHANICAL ENGINEERS

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B.S. in M.E. required with two to six years' experience in industry.

Full benefits, professional status, opportunity for advancement. Relocation allowance, Philadelphia location. Send complete resume to A. C. Eckerman.

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POSITIONS OPEN

Applications are invited for an Associate Professorship and Lectureships/Senior Lectureships (2) and Lectureships (2) in Mechanical Engineering from graduates in Science or Engineering with strong research interests in any of the following: Analytical Methods in Applied Mechanics; Kinematics and Theory of Machines; Thermodynamics; Combustion; Fluid Mechanics; Control and information Theory; Turbines and Rocket Propulsion; Elasticity and other branches of Engineering Science. The available facilities include access to the High Speed Computer SILLIAC. For further information write to the Registrar, University of Sydney, Sydney, Australia, with whom applications close on 31st January, 1961.

EXPANDING OPPORTUNITIES FOR RESEARCH and graduate instruction at master's and doctor's level. Steady growth has created a need for highly qualified persons with a doctor's degree and a background of research and teaching in one of the following fields: Mechanical Dynamics; metallurgy; thermodynamics; applied physics; mathematics (statistics and operations research); electrical engineering (electronics and control). Contact Dean of the Hartford Graduate Center, Rensselaer Polytechnic Institute, East Windsor Hill, Connecticut.

MECHANICAL ENGINEERING teaching position starting September 1961. Man with Ph.D. (preferred) or Master's Degree whose field of specialization is either fluid mechanics, heat transfer and thermodynamics or machine design and stress analysis. New engineering school with excellent facilities. Salary and rank will depend upon qualifications. Apply to: Chairman of the Division of Engineering, Sacramento State College, Sacramento 19, Calif.

Our expansion provides opportunity for enterprising MECHANICAL ENGINEERS, both experienced and recent graduates, in the field of central station and industrial power house equipment. Positions are available in sales, machine design, product development, and administration. Stock Equipment Company, 731 Hanna Building, Cleveland 15, Ohio.

ASSISTANT OR ASSOCIATE PROFESSOR, M.S. or Ph.D. in Mechanical Engineering; to teach Thermodynamics, Heat Transfer and Gas Dynamics. Rank and salary commensurate with qualifications. Position available January 30, 1961. Midwest. Address CA-7046, care of "Mechanical Engineering."

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Scientists, Engineers & Executives, Inc.
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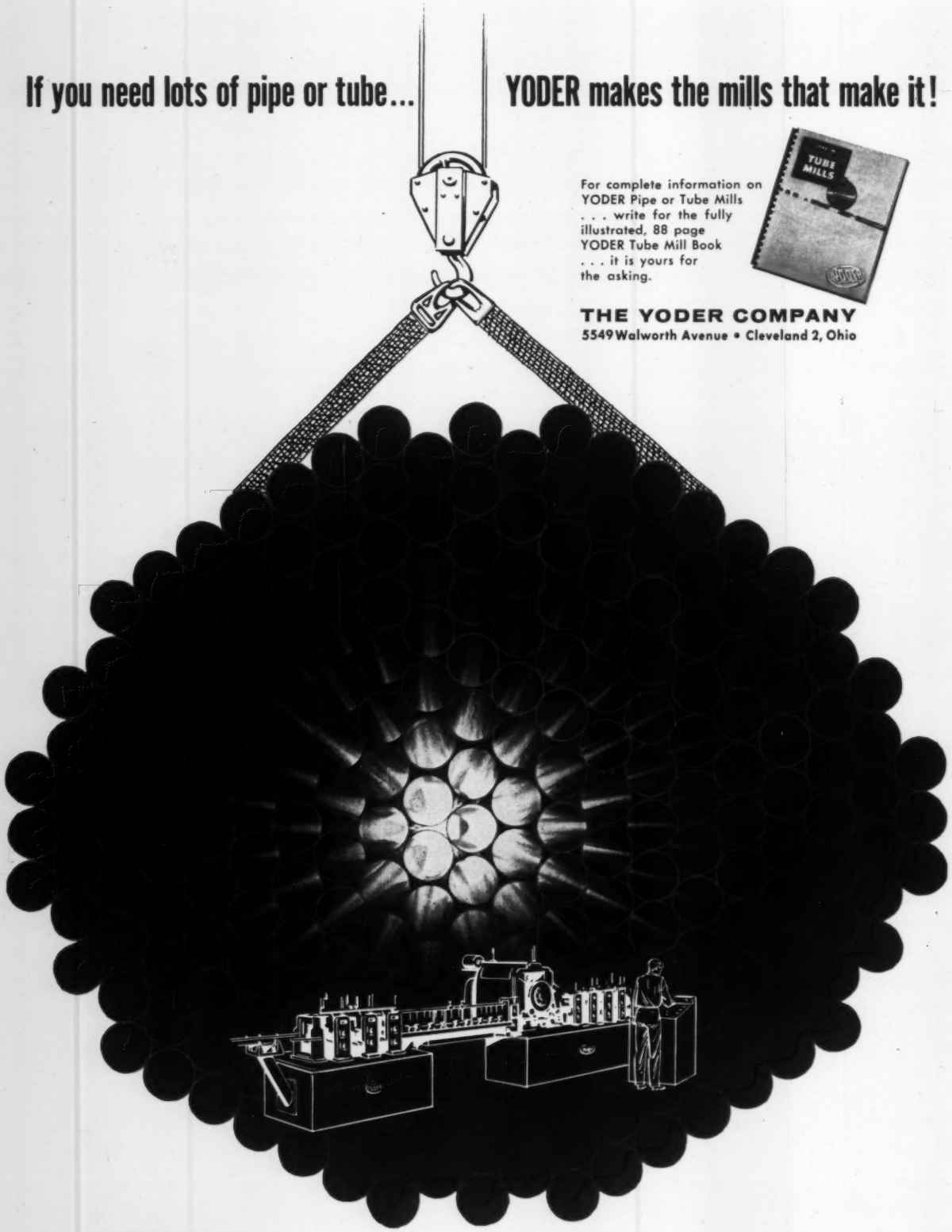

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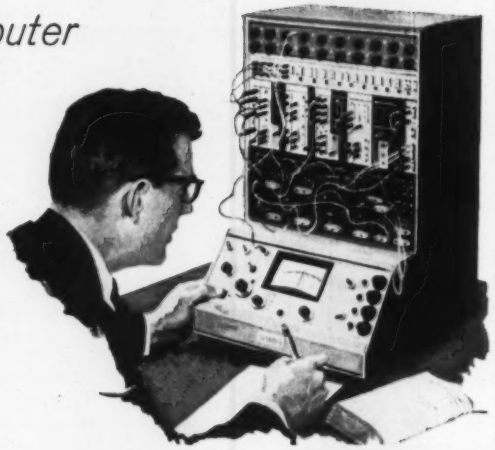

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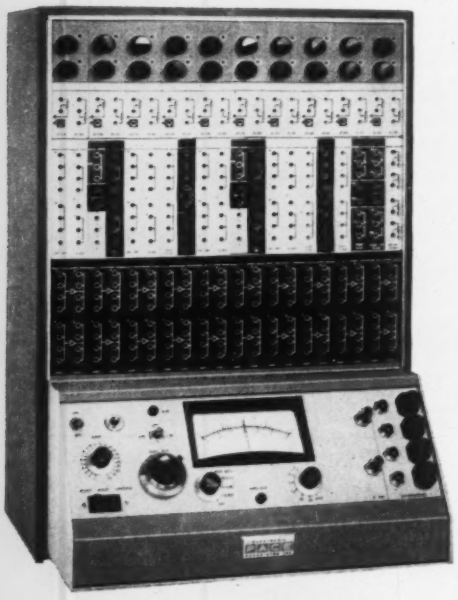

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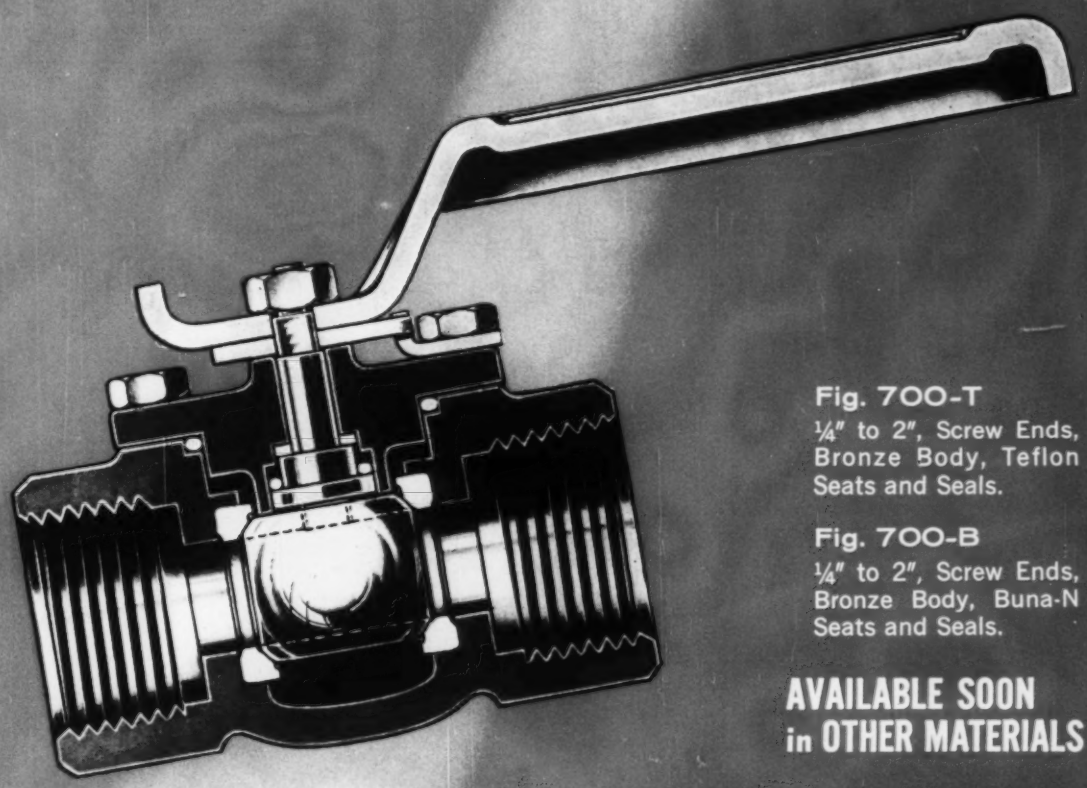

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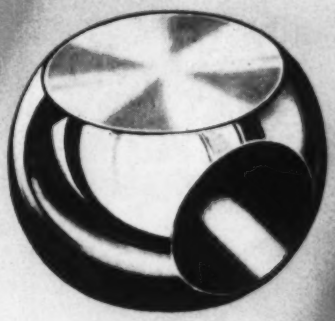

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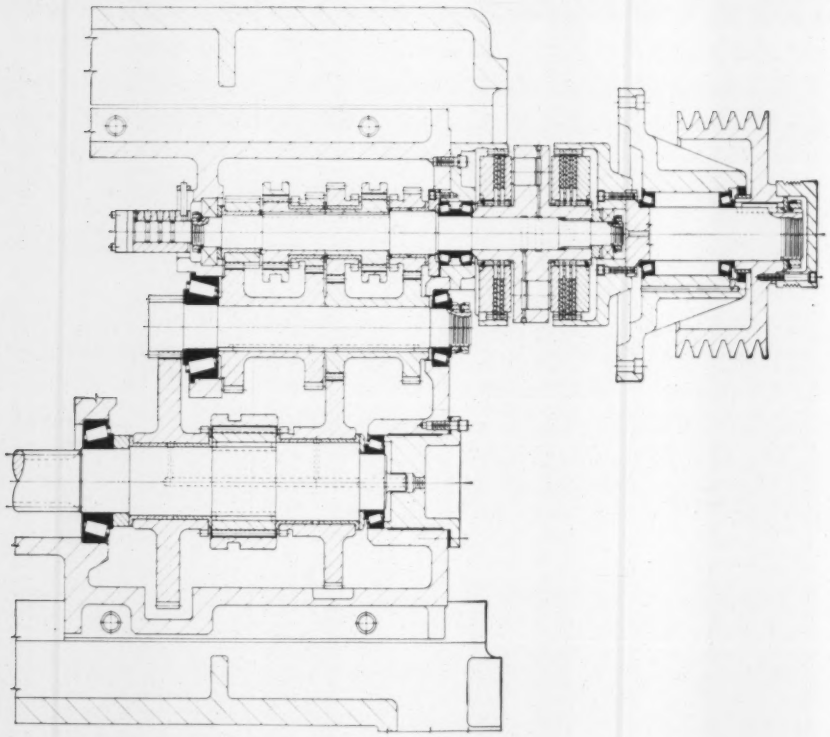

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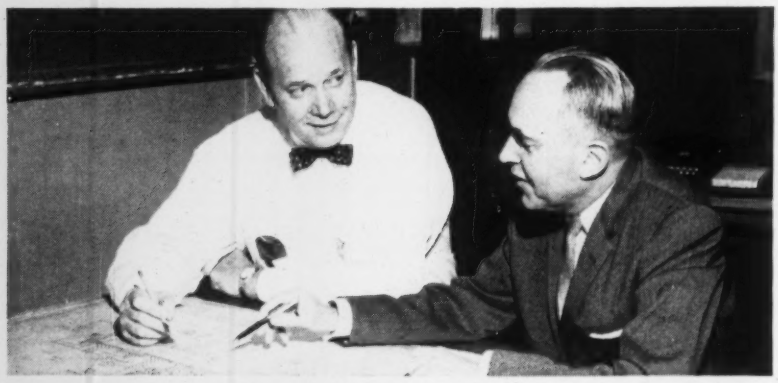

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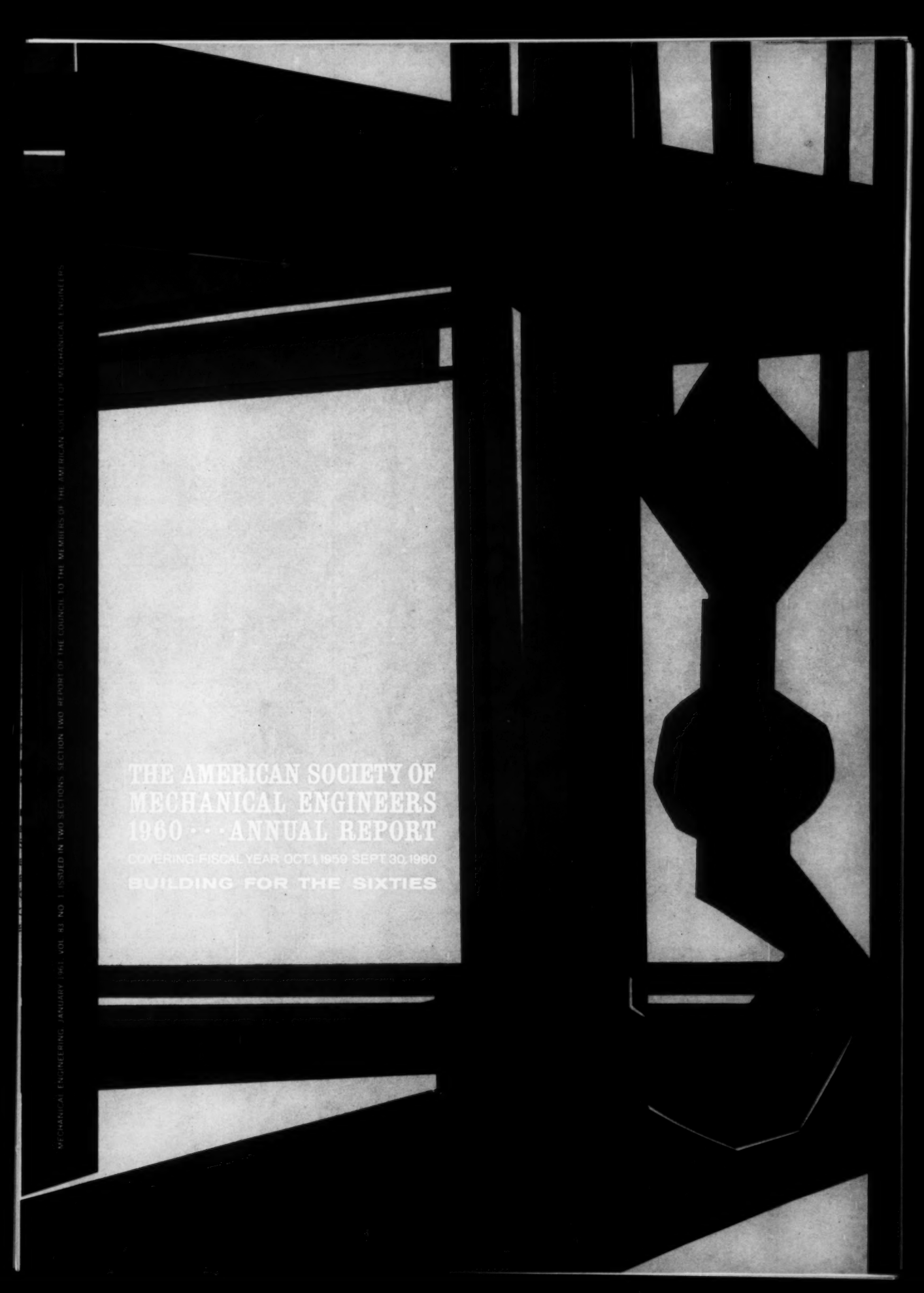
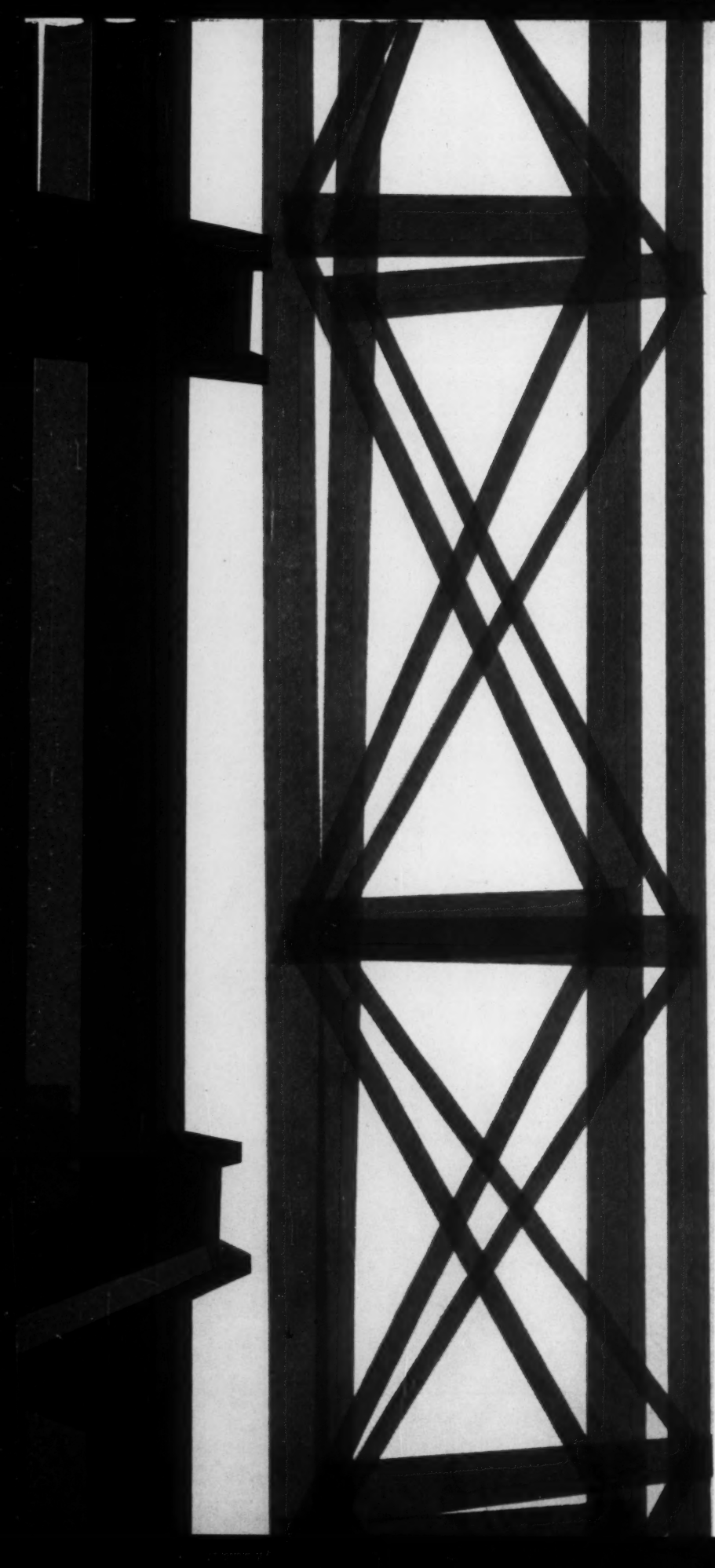


THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS 1960 · · · ANNUAL REPORT

COVERING FISCAL YEAR OCT. 1, 1959 SEPT. 30, 1960

BUILDING FOR THE SIXTIES

MECHANICAL ENGINEERING, JANUARY 1961, VOL. 83, NO. 1, ISSUED IN TWO SECTIONS. SECTION TWO REPORT OF THE COUNCIL TO THE MEMBERS OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS



BUILDING FOR THE SIXTIES

The decade of the 1960's will present a challenge to engineering unparalleled in the history of mankind.

Never before in the history of the world will so much depend on the performance of a single profession.

This belief underlies many of the activities of The American Society of Mechanical Engineers during the past year. Today, mankind is on the threshold of manned space travel. Conquest of disease, poverty and ignorance, made possible largely by engineering's advance, is within our grasp, with all that this implies in respect to war or peace, survival or death. Military might, national survival, economic competition—all of these hinge on engineering. The future of this earth and, not impossibly, other earths and other solar systems, depends on the products of engineering.

Inevitably, the 1960's will be a crucial decade.

It is in the light of these facts that The American Society of Mechanical Engineers has, this year, reviewed its role in supporting the engineering profession and taken steps to assure continued effectiveness in the future. Many of the decisions of the Society were guided by the knowledge that action today is essential to survival tomorrow.

Clearly, engineers who will play such a vital role in this critical decade will require information, guidance, and professional support, made available to them at an unprecedented speed and will benefit by exchanging thoughts with each other.

Recognizing the unique role played by a professional society in supplying these needs, the Council of ASME takes pride in this report to the members, on the work of our great Society this year. This is a report on a year of building for the Sixties.

The 57,000 members of The American Society of Mechanical Engineers belong to one of the world's leading technical organizations. Founded in 1880, the Society is a major factor in the dissemination of technical information in all fields of mechanical engineering and in encouraging the professional development of individual engineers and the progress of the engineering profession.

The Members of the Society are organized into nearly 100 Sections in the United States, Canada and Mexico. Under a recent reorganization, these Sections, in turn, are grouped into ten Regions, each represented by a Vice-President who serves as a member of the Council. Some 2,000 members, most of them living abroad, are not members of any Section, but share in all other ASME activities.

In addition to Sectional and Regional activities, which are largely decentralized and operate in specific geographic areas, the Society carries on work at the national level under the direction of the Council. Six major Boards, 24 Professional Divisions and several hundred additional committees and sub-committees are directly responsible for this work, some of which is described in this report.

Helping to execute the policies of the Council is a headquarters staff in New York City of approximately 140 persons, under the administration of the Secretary.

Necessarily, this report covers only highlights of the Society's year. Detailed reports of the activities of each Board and Committee are available through the Office of the Secretary.

A MESSAGE FROM THE PRESIDENT

Far-reaching events and fundamental changes in human affairs have marked the eighty years that have passed since the founding of ASME. Progress in technology and engineering has been a motivating factor in much that has come to pass.

Our Society has grown with our profession in services to members and in technical undertakings important to the world around us. Growth and change are closely related. This Annual Report summarizes progress made during the year and suggests some of our problems and opportunities in the decade ahead of us.

When I became your president a year ago, I felt that there were several aspects of ASME toward which I could devote my endeavors constructively. I felt, too, a keen concern as to the broad future of ASME, its members and its prestige, both on this continent and elsewhere in the world.

As one who has had some experience as an engineer and as a manager in business, I examined our Society's purpose and organizational structure; the extension, both geographically and in terms of special professional interests of the membership; the great amount of work carried by committees on a volunteer basis; the work done so well on codes and standards; the great number of meetings held and of papers presented; the voluminous activities of editing and publishing; the services performed by our staff at the national headquarters. I visited many sections, conferred informally with members and presided over meetings, such as those of the Council, where matters of policy importance are given careful deliberation.

It has been a busy year, in many ways one of receiving into my hands the long-range projects of my distinguished predecessors so that I might pass them on, with some progress along the way, to my good friend, William Byrne. As he takes up the tasks of the office for which his talents qualify him so highly, I wish to pledge my continued support and assistance.

During my term I have considered deeply the value of ASME to the individual engineer, how it can elevate his endeavors to broader concepts of service and to wider horizons of influence. The modern engineer has it in him to accomplish technical work of a high order. Moreover, he can be a most constructive force in community, state, national and international affairs.

For example, there are serious imbalances in the present world situation as to population, natural resources, energy and technology. Millions exist close to the edge of subsistence. Human values are in jeopardy and countless individuals with great potential find little opportunity for self-development and social usefulness. Historically, in the more fortunate countries, tremendous progress has been made by the application of science and engineering to environmental opportunities. Much the greater part of our work remains to be done for the world at large and the need is most urgent. Here is a mission for the engineer and one to which ASME can bring powerful assistance.

To meet this challenge during the Sixties, our Society must be strengthened internally as to organization and it must have your earnest support along the way. Toward this end, may I share with you these observations and recommendations, derived from my experience after nearly a year in the office of president of ASME:

1) I have great hope for the study that is now being conducted by Cresap, McCormick and Paget, a recognized firm of management advisers having broad experience in the affairs of nonprofit organizations and professional associations.

They will seek to identify our objectives—what ASME thinks it should be or can be in the prac-

tical world of today. Within the agreed-upon limits of time and budget, they will study our membership, divisions, regions and sections, central staff and voluntary committees, meetings and conventions and publications program. A questionnaire will be sent to a statistically significant sample of ASME members and their prompt cooperation will be needed.

Out of this study, conducted with the advantage of an outside point of view, should come definite conclusions about ASME on which we can take action to strengthen our Society for the challenge of the Sixties.

2) I have been greatly concerned over the difficulty that we are encountering in reaching our goal on contributions for our share in the United Engineering Center. Some sections have had splendid results, exceeding their quotas by fifty per cent or even more. A greater number of sections has fallen far short of expectations. At this writing, ASME is still about ten per cent short of the necessary sum.

Without question, the UEC will serve fundamental and pressing needs of the Society and the long-range interests of our profession. I hope that members who have not contributed will reconsider their estimate of personal responsibility and help us to reach our quota.

3) For more than a decade we have been aware of the need for closer relationships between the leading engineering societies. Last June in Dallas I requested Ronald Smith and Donald Marlowe to meet with similarly designated members of other societies to undertake discussions along lines that showed considerable promise. They have worked most capably and I feel that substantial progress has been made. I appreciate their endeavors.

4) There is reason for encouragement concerning our international relations, but I think we will have to work aggressively in this direction to follow up and to expand upon what we have thus far accomplished. There are important engineering societies in Western Europe, South America, the western Pacific area and in the USSR. Many and indeed all of these need a reaffirmation and expansion of their relationships to us.

There is also the need for us to find the personnel and the money so that we may be represented adequately in meetings on standards abroad. Standardization agencies of many countries are, in effect, governmental bodies. For the prestige of American industry and as supporters of individual enterprise, we must demonstrate our capacity to fulfill our mission in this respect.

5) ASME is a volunteer society, dependent upon the willingness of experienced members to serve at the sectional, regional and national level. We can be justly proud of the many men who give generously of their time and ability in these ways. By and large, this decentralization has been effective and we know that the Council guides our affairs with wisdom and foresight.

As we are now constituted, the president of ASME has little executive responsibility for the effective management of our affairs. Procedural measures growing up silently over the years have made it traditional that, in effect, the management of ASME is in the hands of committees.

We would be well advised to ask ourselves whether this is in all respects the most effective organizational structure for so large an association, whether it has kept pace with our growth, with what is happening around us, and with our future needs.

6) Finally I recommend that it would be helpful to a president, because of the complexity of the matters that require his attention during a relatively brief term, if he had the assistance of an advisory policy committee made up of the five immediate past presidents. The need for such an informed source of counsel may well increase as our Society grows in stature in the years ahead.

My term of service as your president has been a pleasant and rewarding experience. It would be a happy but almost infinite task to name all who have given me, in friendship and mutual purpose, the cooperation for which I am deeply appreciative.

To each and all of you, my warm friends and associates in ASME, may I express my sincere thanks and good wishes.

Walker L. Cisler

WALKER L. CISLER
November, 1960

and organizations to new or revised standard
and thereby encourage their acceptance and use

Meantime, the Committee must continue to dea
with perennial problems such as judging the ex
tent to which new knowledge and new material
permit revision of the existing standards in way
that will permit more efficient and economical de
sign and construction without sacrificing safety
Such problems, which have jumped dramatically
in recent years, are expected to accelerate in th
future as new research, notably in the field o
rocketry, pours forth a flood of new data on tem
peratures, pressures and materials.

POWER TEST CODES. The Power Test Cod
group is headed by a Standing Committee of 2
men and supervises the work of some 35 technica
committees. These committees have complete
and published 28 test codes and 28 supplementar
pamphlets dealing with instruments and method
of measurement.

Two committees dealing, respectively, with Dis
placement Compressors and Fans were reor
ganized during the year. A new technical com
mittee, Number 30, was organized to write a tes
code for atmospheric cooling equipment and i
now holding regular meetings.

The Power Test Codes Committee also reporte
that a revised Manual of Procedure for Powe
Test Codes Committees is in process.

Substantial progress was made during the yea
on revised codes dealing with steam turbines
displacement pumps, and centrifugal pumps
Within the series on instruments and apparatus
Supplements on Temperature Measurement an
Measurement of Shaft Horsepower of Rotatin
Machines by Direct and Indirect Methods, wer
prepared for final printing.

BOILER AND PRESSURE VESSEL CODE. Th
Boiler and Pressure Vessel Committee is one o
the most active of the group at work in the code
and standards field. Its Main Committee consist
of 23 members and it has organized over 30 sub
committees, several special committees, and
Conference Committee. The ASME Boiler an
Pressure Vessel Code is in wide use throughou
industry, and one or more sections have been ac

cepted by 38 states, and all of the provinces of Canada.

In 1960, the Boiler and Pressure Vessel Committee embarked on a two pronged effort. One aspect was speedy execution of day-to-day revisions and additions to deal with new problems, new materials and new operations to keep the Code abreast of the times.

In particular, nuclear power plants now under construction or planned, brought a host of new problems requiring the Committee's attention, and have helped to swell the total of inquiries and requests to well over 500 for the year.

The Committee has noted, in fact, a growing desire for an entire new section of the Code, to supplement the existing eight, that would deal with nuclear plants alone. At present, nuclear plants are dealt with as special cases of the existing code.

The second stage of the Committee's effort was directed toward reorganization of subcommittees to enable them to deal more effectively with problems anticipated for the next decade. This review and reorganization is well under way.

Another recurring problem—requests for advice on design of specific boilers or vessels was met with a partial solution. While maintaining its position that it cannot give consulting advice, the Committee encouraged the publication by ASME of a massive collection of some of the most valuable papers on the design of piping systems, pressure vessels and related items delivered at Society meetings over the years. This volume, inspired by the Boiler and Pressure Vessel Committee, and issued by the ASME Publications Committee, has met a remarkable response.

Working committees—this one, the Subcommittee on Strength of Vessels Under Exterior Pressure—meet throughout the year to keep codes and standards up to date. Their role, often unappreciated or even unnoticed, is vital to ASME programs in this area.

An example of growing interest in international standards is the work done at a meeting of Technical Committee #11 of the International Organization for Standardization in Dusseldorf, Germany, in the summer of 1960. At this meeting, progress was made toward recommended practices for construction of stationary steam boilers, covering the United States, Britain, France, West Germany, Belgium, Italy, the Netherlands, Switzerland and Czechoslovakia.

There seems to be a growing demand for a truly international boiler code, which would, of course, require resolution of substantial differences between nations in approaches to design, construction and inspection. Additional pressures for more rapid revision of the code are expected to grow as other countries, including some behind the Iron Curtain, enter foreign markets.

Similarly, there seems to be growing interest in revising the codes that deal with boilers on the one hand and pressure vessels on the other to bring design requirements more closely in line with one another. Although many of the present differences are minor, such a revision would represent a huge task of revision and coordination.

INTERNATIONAL ELECTROTECHNICAL COMMISSION. Under the general administration of the Board on Codes and Standards are ASME's activities on the International Electrochemical Commission. The ASME representatives on the U. S. National Committee and the USNC Council of the International Electrotechnical Commission report that progress was made in each of the three technical committees with which ASME is concerned. These deal with Hydraulic Turbines, Steam Turbines, and Internal Combustion Engines.

PUBLICATIONS

Much of the end product of ASME activities appears in the form of printed matter. Publications, in the broad sense, account for well over half of the Society's expenditures and income.

Most familiar of all ASME publications is *Mechanical Engineering*, mailed to all members each month. Since January, 1960, *Mechanical Engineering* has featured a special report or survey each month on such topics as: The Nation's Water Resources, Progress in Railway Mechanical Engineering, Developments in the Fields of Plastics and Rubber, Man and his Thermal Environment, Safety in Materials Handling, and reviews of literature in Heat Transfer and Metal Processing. A special issue on design engineering was published in May to coincide with the ASME Machine Design Conference and concurrent exhibit at the Coliseum in New York.

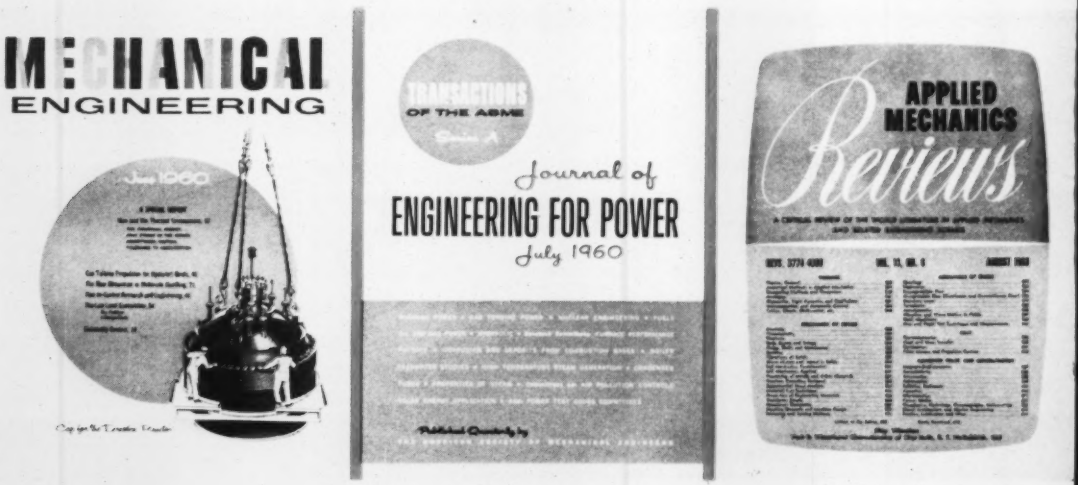
TECHNICAL PAPERS. Over 700 technical papers scheduled for presentation at meetings were produced in 1960. Because of rising production costs, prices of these papers were increased in June. The new prices, 50 cents to members, and $1 to nonmembers, more nearly coincide with those established by other engineering societies.

TRANSACTIONS. The procedure, initiated last year, of publishing the traditional *Transactions of the ASME* in five quarterly journals was continued with a resultant increase in their apparent utility, as well as their circulation.

There are now 21,376 subscribers to these Journals. This compares to about 5,000 for the eight issues of *Transactions*, and 6,000 for the *Journal of Applied Mechanics* under the old method of publication.

In conjunction with the new *Transactions* plan, a family of covers was designed for the new journals. In addition, the format was modified, and type faces restyled to permit easier and faster reading.

APPLIED MECHANICS REVIEWS. *Applied Mechanics Reviews*, now in its 13th year, is recognized around the world as an indispensable tool for the engineering scientist interested in the mechanical arts and sciences. This year, some 3,500 copies were distributed of each issue.



NEW PUBLICATIONS IN FISCAL 1960

BOOKS

Proceedings, 1960 Design Engineering Conference
Technical Data on Fuels
Small Plant Management
1959 Report on Oil and Gas Engine Power Costs
Compressor Stall, Surge and System Response
Pressure Vessel and Piping Design
Friction and Wear in Machinery
Manufacturers of Dust and Fume Control Equipment
Shock & Structural Response
The Role of Viscosity in Lubrication
Fifty Years Progress in Management

AMERICAN STANDARDS

American Standard Drill Drivers ASA B5.27
Letter Symbols For Rocket Propulsion ASA Y10.14
Cast-Bronze Solder-Joint Drainage Fittings ASA B16.23
Wrought-Steel and Wrought-Iron Pipe ASA B36.10
Large Rivets ASA B18.4
Square and Hexagon Bolts and Nuts ASA B18.2
Machine Tapers ASA B5.10
Time Series Charts ASA Y15.2
Milling Cutters ASA B5.3
Unified Screw Threads ASA B1.1
Cast Iron Pipe Flanges and Flanged Fittings Class 125 ASA B16.1
Cast-Iron Pipe Flanges and Flanged Fittings Class 250 ASA B16.2
Spindle Noses and Arbors for Milling Machines ASA B5.18
Pipe Threads (Except Dryseal) ASA B2.1
Dryseal Pipe Threads ASA B2.2
Rotating Air Cylinders and Adapters ASA B5.5
American Drafting Standards Manual, Sec. 15, Electrical Diagrams ASA Y14.15
Involute Splines, Serrations and Inspection, ASA B5
Aerial Passenger Tramways ASA B77.1
Elevators, Dumbwaiters, and Escalators ASA A17.1
Practice for the Inspection of Elevators ASA A17.2
Involute Splines, Serrations, and Inspection ASA B5.15
Spindle Noses for Tool Room Lathes, Engine Lathes, Turret Lathes, and Automatic Lathes ASA B5.9
Electrical Diagrams for Electronics and Communications ASA Y14.15

NATIONAL MEETINGS & CONFERENCES

Geography, and the Society's desire to serve more completely all parts of the country, played a major role in the decisions of the meetings committee in 1960.

For several years, the committee has recognized the need for offering improved general meetings, and full-scale business meetings at locations other than New York, Chicago, and Atlantic City.

Unfortunately, it is only in these limited areas that sufficient hotel space can feasibly be committed to accommodate groups as large as that drawn by ASME's Winter Annual Meeting.

Several years ago, the decision was reached to abandon, for the time being at least, the Fall and Spring general meetings of ASME, and to concentrate instead on a more complete and representative Summer Annual Meeting, which would be valuable and significant in ways that a Division Conference cannot be, and at the same time, of a size that can be accommodated at many sites.

Plans call for Summer Annual Meetings to be held during the next few years in Los Angeles, Cincinnati, Pittsburgh, Cleveland and San Francisco.

Shifts in administrative procedure described elsewhere in this report, including inauguration of the new national officers at the Summer Annual Meeting, emphasize the increased stature of this event. This increased emphasis, the committee hopes and expects, will help bring the advantages of a general ASME meeting to more members and more sections of the country than ever before.

THE FIGHT FOR TIME. Conflicting demands upon the time of engineers throughout the country have grown in persistency and intensity in recent years.

On the one hand, the engineer is expected to be intimately familiar with new developments in his own specialty, to keep up with major progress in related fields, and to remain aware of the state of the art of engineering as a whole. On the other hand, the pressure of day to day work often prevents him from attending all of the meetings or reading all the literature that would enable him to do this.

To help each engineer to achieve his objectives without making immoderate demands on his time several important steps have been taken by ASME. Notable among these is an increased emphasis on joint conferences which, by combining the resources of two or more sponsoring societies permits a high concentration, at a single meeting, of papers and discussions of the highest quality. During the fiscal year, thirteen of the twenty four national conferences, in which ASME participated, were jointly sponsored with another Society. Others were co-sponsored by two or more Divisions.

An outstanding example of these joint efforts was the Joint Automatic Control Conference held at Massachusetts Institute of Technology and sponsored by five leading groups. This first venture of its kind exceeded all expectations in terms of attendance and quality of information presented.

As noted elsewhere in this report, the system inaugurated last year of splitting The Transactions of the ASME into five quarterly journals each dealing with a specific field of endeavor gained momentum during the year as subscribers learned that by selecting their journals carefully they could obtain a concentrated diet of information of interest to them and reduce the cost in time and money at the same time.

Naturally, not all members find it possible to attend national meetings and conferences, despite efforts to decentralize such events. To serve the needs of such members, some 1500 meetings were held by Sections in virtually every part of the country. In addition, an estimated 900 meetings were held on college and university campuses under the auspices of ASME's 140 student sections.

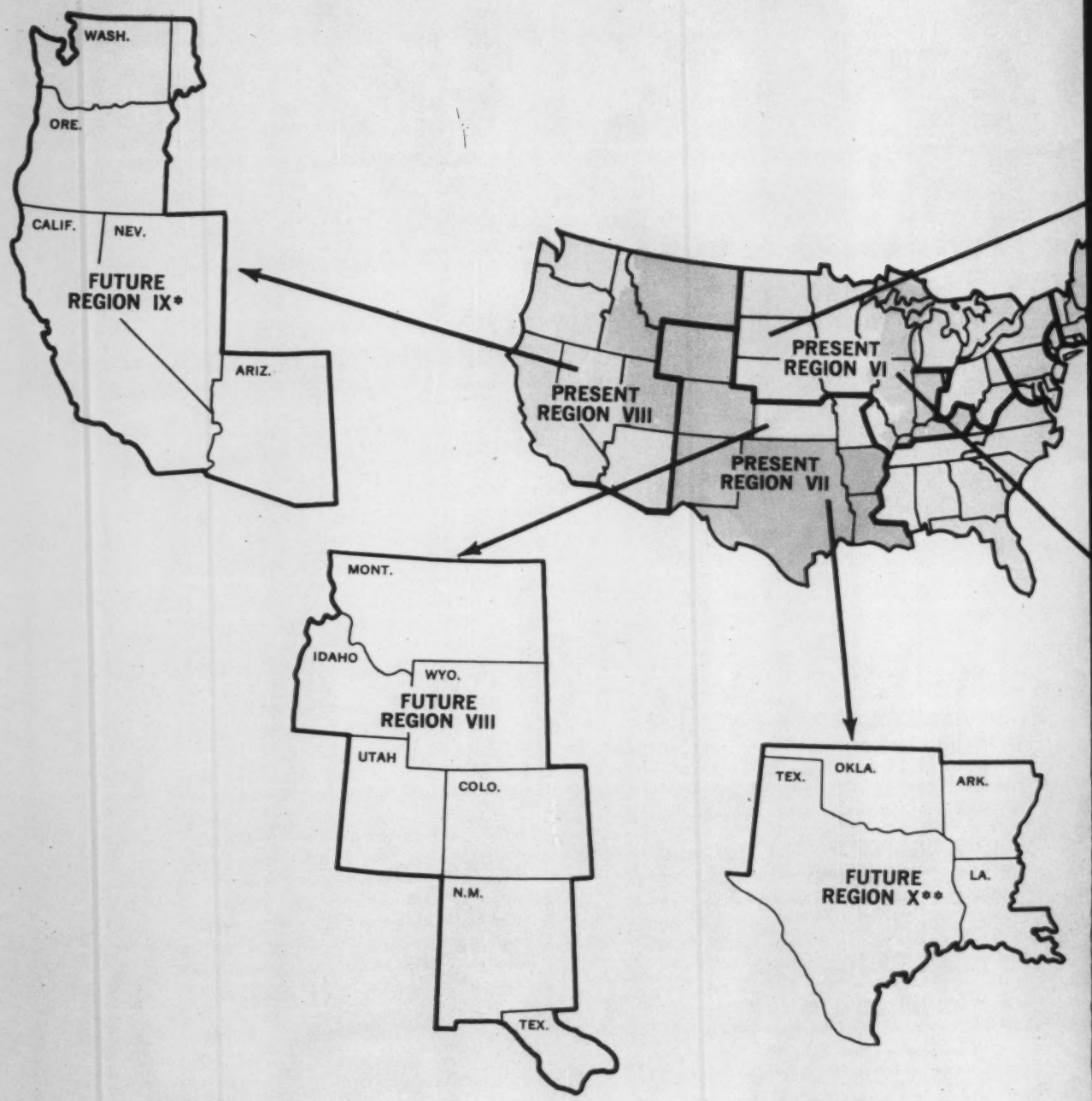
ASME Meetings and Conferences 1959-1960

(Unless otherwise designated the conferences are sponsored solely by ASME or its Divisions. Listed in chronological order.)

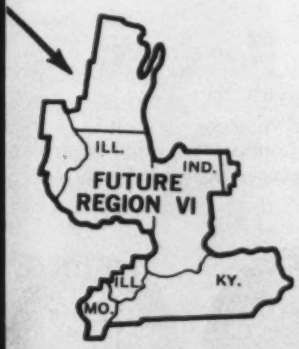
	Sessions	ASME Papers	Copies Available	Attendance
ASME-ASLE Lubrication Conference New York, N. Y.	7	15	11	300
ASME-AIME Fuels Conference Cincinnati, Ohio	4	12	5	170
ASME-IRE-AIEE-ISA National Automatic Control Conference Dallas, Texas	8	4	4	100
Annual Meeting Atlantic City, New Jersey	107	350	312	4000
Gas Turbine Power Conference & Exhibit & Hyd. Div. Conf. Houston, Texas	20	49	18	840
Lubrication Symposium New York, N. Y.		16	3	133
American Power Conference Raleigh, N. C.	1	3	*	3000
Nuclear Congress & Exhibit New York, N. Y.	14	*	2	5000
ASME-SAM Management Engineering Conference New York, N. Y.	8	*	*	900
Joint Conference on Automatic Techniques Cleveland, Ohio	4	4	4	100
ASME-AIEE Railroad Conference Pittsburgh, Pa.	4	6	6	280
Maintenance & Plant Engineering Conference St. Louis, Mo.	4	8	7	128
Metals Engineering Div.—AWS Conference Los Angeles, Calif.	4	14	12	923
Production Engineering Conference Milwaukee, Wis.	9	30	18	287
Oil & Gas Power Conference & Exhibit Kansas City, Mo.	6	13	13	507
Design Engineering Conference & Exhibit New York, N. Y.	8	12	12	1392
Summer Annual Meeting & Aviation Conference Dallas, Texas	45	110	91	709
Applied Mechanics Conference University Park, Pa.	6	31	31	154
Applied Mechanics Western Conference Pasadena, Calif.	5	15	15	150
ASME-AIChE Heat Transfer Conference & Exhibit Buffalo, New York	12	38	38	865
Joint Automatic Control Conference Cambridge, Mass.	17	12	12	689
ASME-AIEE Engineering Management Conference Chicago, Ill.	4	*	*	200
Petroleum Mechanical Engineering Conference New Orleans, La.	26	55	49	725
ASME-AIEE Power Conference Philadelphia, Pa.	6	10	7	935
Total	333	807	670	22,287

* Not printed as ASME papers.

ASME MEMBERSHIP



*Includes Hawaii
**Includes Mexico



REGION I	
Boston	1518
Fairfield County	466
Hartford	630
New Haven	224
New London	137
Northern New England	260
Providence	313
Waterbury	152
Western Massachusetts	232
Worcester	241
Total	4173

REGION II	
Long Island	819
Metropolitan	2518
Mid-Hudson	184
Mid-Jersey	777
North Jersey	1538
Total	5836

REGION III	
Anthracite Lehigh Valley	442
Baltimore	699
Buffalo	353
Central Pennsylvania	136
Delaware	465
Hudson Mohawk	600
Mohawk Valley	93
Olean	129
Philadelphia	2138
Rochester	305
Southern Tier	352
Susquehanna	204
Syracuse	255
Washington, D. C.	773
Total	6944

REGION IV	
Atlanta	307
Birmingham	277
Central Savannah River Area	136
Central Virginia	202
Chattanooga	280
East Tennessee	317
Eastern North Carolina	158
Eastern Virginia	183
Florida	277
Greenville	129
Gulf Coast	101
Miami	117
North Alabama Mississippi	181
North-East Florida	95
North-West Florida	135
Palm Beach	76
Piedmont-Carolina	296
Savannah	99
Virginia	198
Total	3564

REGION V	
Akron	363
Canton-Alliance-Massilon	204
Central Michigan	138
Cincinnati	698
Cleveland	777
Columbus	404
Dayton	307
Detroit	1071
Erie	214
Ontario	512
Pittsburgh	1174
Toledo	211
West Virginia	296
Westmoreland	295
Youngstown	133
Total	6797

REGION VI	
Central Illinois	289
Central Indiana	413
Chicago	246
Fort Wayne	79
Iowa-Illinois	221
Louisville	213
Milwaukee	736
Paducah	70
Rock River Valley	227
St. Joseph Valley	165
Total	4459

REGION VII	
Central Iowa	171
Central Kansas	133
Kansas City	456
Minnesota	456
Nebraska	173
St. Louis	513
Total	1902

REGION VIII	
Idaho-Montana	115
New Mexico	336
Rocky Mountain	386
Utah	148
Total	985

REGION IX	
Arizona	249
Columbia Basin	144
Hawaii	104
Inland Empire	57
Los Angeles	2700
Oregon	189
San Diego	276
San Francisco	1711
Western Washington	569
Total	5999

REGION X	
ArkLaTex	137
Mexico	97
Mid-Continent	464
New Orleans	358
North Texas	560
Sabine	106
South Texas	804
Total	2526
Members in Sections	43198
Not in Sections	2506
Student Members	11557
Grand-total	57261

One of the fundamental activities of ASME is administering a program of honors and awards. This program helps to compensate individuals or organizations for outstanding achievements or contributions to the profession. It also helps focus the attention of the world on engineering as a major factor in modern life and to highlight engineering advances. Below is a list of honors and awards announced by ASME during 1960.

Honorary Membership

HENRY TOWNLEY HEALD, Member, ASME
President, The Ford Foundation

"For outstanding accomplishment as an educator and for public service to his City, State and Nation."

ASME Medal

CARL RICHARD SODERBERG, Fellow, ASME
Institute Professor,
Massachusetts Institute of Technology

"For his contributions to the development of steam and gas turbines for power generation and for propulsion units in naval vessels and in aircraft."

ASME George Westinghouse Gold Medal

ERNEST CHARLES GASTON, Member, ASME
President, Southern Services, Inc.

"For distinguished leadership in generating station design and operation in the development of a major power system."

Timoshenko Medal

CORNELIS BENJAMIN BIEZENO
Technological University, Delft, Holland and
RICHARD GRAMMEL
Stuttgart Institute of Technology
Stuttgart, Germany

"For invaluable contributions to applied mechanics, including numerous individual publications, joint authorship of the widely accepted book, "Technische Dynamik," and inspiring leadership in the International Congresses of Applied Mechanics."

Machine Design Award

RUDOLPH EARL PETERSON, Fellow, ASME
Westinghouse Electric Corp.

"For eminent achievement and distinguished service in the field of mechanical design; for numerous creative contributions and teaching in research, development, application, and design of machinery to prevent mechanical failure; for outstanding accomplishment in the development of young engineers and scientists, both through his industrial and his university associations."

Worcester Reed Warner Medal

LLOYD HAMILTON DONNELL, Member, ASME
Research Professor, Mechanics
Illinois Institute of Technology

"For his outstanding contributions to the permanent engineering literature as exemplified by his many papers in the field of applied mechanics ranging from the theory of buckling of thin shells to the development of new methods for testing aircraft structure, and his role in establishing 'Applied Mechanics Reviews'."

Melville Medal

WILLIAM GODFREY STELTZ, Associate Member, ASME
Development Engineer, Steam Division
Westinghouse Electric Corporation

For his paper, "The Critical and Two-Phase Flow of Steam."

Prime Movers Committee Award

SIGMUND NICHOLAS FIALA, Member, ASME
Vice President, American Electric
Power Service Corporation

For his paper, "First Commercial Supercritical Pressure Steam-Electric-Generator Unit for Philo," and

JAMES HAYWARD HARLOW, Fellow, ASME
Chief Mechanical Engineer
Philadelphia Electric Company

For his paper, "Engineering the Eddystone Plant for 5000 Lb.—1200 Degree Steam."

Principal Supporting Papers

C. W. ELSTON, Member, ASME and
R. SHEPPARD, Member, ASME

"First Commercial Supercritical Pressure Steam Turbine Built for the Philo Plant."

W. H. ROWAND and A. M. FRENDBERG

"First Commercial Supercritical Pressure Steam Generator for Philo Plant."

C. B. CAMPBELL, C. C. FRANCK, SR., and J. C. SPAHR

"The Eddystone Superpressure Unit."

R. C. ULMER, H. A. GRABOWSKI and
R. C. PATTERSON

"Water-Treatment, Corrosion, and Internal-Deposit Studies for Eddystone."

E. M. POWELL

"Engineering the Eddystone Steam Generator for 5000 p s i g, 1200 Degree Steam."

Blackall Machine Tool and Gage Award

BOAZ POPPER,
Scientific Department
Israel Ministry of Defense and
DAVID WOLFGANG PESSEN, Associate Member, ASME
Dept. of Mechanical Engineering
Israel Institute of Technology

For their paper, "The Twinworm Drive—A Self-Locking Worm-Gear Transmission of High Efficiency."

Junior Award

GUNNAR HESKESTAD, Associate Member, ASME
Research Assistant,
The Johns Hopkins University and
DUANE ROBERT OLBERTS, Associate Member, ASME
Engineer, Deere & Company

For their paper, "Influence of Trailing-Edge Geometry on Hydraulic-Turbine-Blade Vibration Resulting from Vortex Excitation."

Arthur L. Williston Medal and Award

MARC FISHZOHN
55 A Rye Colony
Rye, New York

For his paper, "The Difficult Perspective."

Richards Memorial Award

ASCHER H. SHAPIRO, Member, ASME
Professor of Mechanical Engineering
Massachusetts Institute of Technology

"For outstanding achievement in engineering within twenty to twenty-five years of graduation."

Pi Tau Sigma Gold Medal Award

GEORGE N. HATSOPOULOS
Associate Professor in Mechanical Engineering
Massachusetts Institute of Technology

"For outstanding achievement in engineering within ten years after graduation."

Charles T. Main Award

JOHN W. MCDANIEL
Rice Institute of Technology
For an undergraduate student.

"For his paper, 'A Program of Continuing Broad Self-Education for the Engineering Graduate'."

Undergraduate Student Award

THEODORE C. KUCHLER, JR.
Lehigh University
For a student member.

For his paper, "Reliability, A New Tool for Design."

Old Guard Prize

JOSEPH W. LINDSEY
University of Utah
For a student member.

For his paper, "A Cold Flow Study of Nozzle Feeding in a Four-Nozzle Rocket Case."

BUILDING FOR THE SIXTIES

Two major steps to modernize the Society's operations and improve efficiency, Regional realignment and a change in operating years, were agreed to in 1960 and became effective during the 1960 Winter Annual Meeting, following approval by ballot of the full membership. Other improvements were planned or continued.

REGIONAL REALIGNMENT. The eight Regions with which ASME began the year became ten by the year's end. This expansion reflects not only the sharp increase in ASME membership, which has tripled in two decades, but the changing patterns of industrial growth which have brought more and more engineers into the western half of the nation. The three Regions which formerly served members west of the Mississippi have become five. Although, in general, Section boundaries were not changed during this realignment, there were also created during the year six new Sections, bringing the Society's total to ninety-nine.

One result of this realignment, in addition to bringing the vice presidents closer to the Sections they serve, resulted in the addition of two vice presidents to the Council, thereby permitting more effective representation of members.

CHANGE IN OPERATING YEARS. In the eighty years of its existence, ASME has established a number of operating years, including a fiscal year from October 1 to September 30, an administrative year from Annual Meeting to Annual Meeting, and a Section and Student Section year commencing on July 1.

Disadvantages imposed by these out-of-phase years were few at first, but as record-keeping and administrative problems grew in complexity with increased membership, conflicts became more serious.

At the 1960 Summer Annual Meeting, steps were taken which resulted in eliminating much of the overlapping of time periods. In the future most of the Society's Operating years will coincide with the new Administrative Year which will begin and end during the Summer Annual Meeting of the Society.

After a period of initial adjustment, the Council is confident that operation of the Society will be substantially improved.

BOARD ON TECHNOLOGY. A major reorganization of administrative procedure has been worked out by the Board of Technology and submitted for implementation by the Constitution and By-Laws Committee.

By delegating authority formerly held by central groups to a series of specialized committees, this plan will encourage more rapid recognition of and reaction to major technological trends, and speedier presentation of new information to the Society's members.

As worked out by a Special Technical Interest Committee appointed by the Board of Technology, the plan calls for three "departments" to supervise the various professional activities of the Society. These three departments will, to some extent, parallel the classifications used by the Publications Committee in organizing its quarterly journals. The departments will deal with Basic Engineering (Applied Mechanics, Heat Transfer, Hydraulic, Instruments and Regulators, Lubrication and Metals Engineering Divisions), Power (Fuels, Gas Turbine Power, Nuclear Engineering, Oil and Gas Power and Power Divisions), and Industry (all other Divisions). Each of these departments will be responsible for activities within its field including encouraging the most effective possible programs of conferences and contributions to the technical literature.

In addition, the plan calls for a Meetings Committee responsible for planning general meetings of the Society that adequately will carry out the objective of providing an opportunity for each member to survey major accomplishments in fields other than his own, and a Publications Committee responsible for satisfying technical interests of all members through publications.

RESEARCH. Fundamental to the concept of preparing for the future by laying the groundwork today is the Society's program of research.

Although ASME does not, itself, subsidize or execute research, it performs a vital role in collecting funds from interested groups and coordinating research programs in areas of nonproprietary interest. Fifteen fundamental programs, including several that have been carried on over a period of years, are currently carried out at installations across the country under ASME contracts totalling more than $400,000.

In addition to these, five ASME research committees provide guidance and advice to research programs sponsored by others, such as a recently completed series of investigations, by the U. S. Atomic Energy Commission, into materials for use in nuclear applications. Concurrently, several other research committees carried out six surveys of the state of engineering knowledge in their areas of interest.

Approximately two thirds of the funds expended on ASME research during the year came

from industrial firms and trade associations, while the remaining third was supplied by government agencies. Additional contributions in the form of time of personnel and the use of the equipment from various sources amounted to several times direct cash expenditures.

Increased activity in five new areas of research was foreshadowed during the year as steps were taken to secure financial support by the ASTM-ASME Joint Committee on Effect of Temperature on the Properties of Metals, the Joint Research Committee on Boiler Feedwater Studies, and research committees on Prevention of Fracture in Metals, Fluid Meters, Lubrication, Contact Fatigue of Rolling Elements and Flow of Bulk Materials. In addition, three committees were organized during the year. These were the Coordinating Committee on Critical Tables, the Guidance Committee on Mechanical Behavior of Metals, and the Research Committee on Effect of Nuclear Radiation on Materials for Construction.

In an effort to broaden the base of research interest within ASME, the Research Executive Committee sought and received permission of the Council to add to the Research Planning Committee representatives of two ASME groups dealing with codes, the Boiler and Pressure Vessel Committee and the Power Test Codes Committee.

Continuing interest of the Society in improving its research committee program was evidenced by the action of the Board of Technology on November 17, 1959, setting up an ad hoc Research Interest Committee to "Review the position, status, extent, organization and objectives of the ASME Research Program." When this committee reported to the Board on Technology on June 7, 1960, it was instructed to continue its studies with the further objective of bringing up to date the Council policy on research last formulated in 1952.

EUSEC AND UPADI. ASME is an active member of both the Conference of Engineering Societies of Western Europe and the United States (EUSEC) and the Pan American Union of Engineering Societies (UPADI). Below is a brief summary of the activities of these groups during 1960.

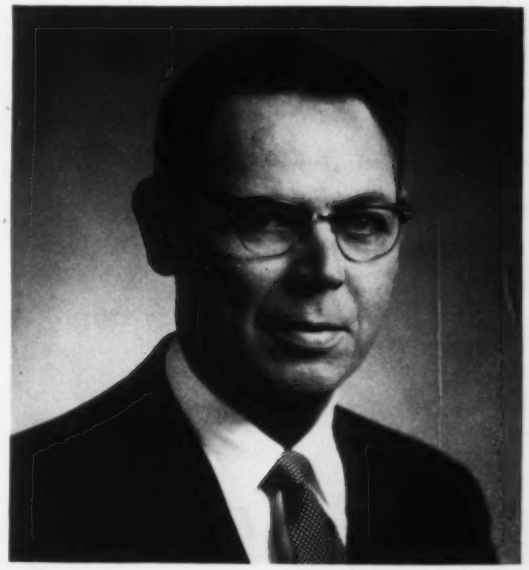
EUSEC. One of the major achievements of EUSEC, which includes representatives from 16 nations, is a unique comparative study of engineering education in nineteen countries. This report, financed by grants totalling $60,000 was approved at the 7th Plenary Meeting of EUSEC in Brussels, Belgium, during 1960 and will be printed in both English and French early in 1961. Other achievements of EUSEC included progress toward an international code of ethics for engineers, discussion of the problems raised by "splinter" engineering societies formed to serve highly specialized interests of small groups of engineers, and consideration of methods by which engineering societies can improve their effectiveness in the field of research.

UPADI. At a conference in Buenos Aires, delegates to UPADI took steps that are expected to result in a comparative study of education in the Western Hemisphere comparable to the study undertaken by EUSEC in Europe.

Major resolutions undertaken by the 1960 UPADI conference called for a program of exchanging technical lecturers between nations, provision for cooperation with the International Commission on Arbitration, encouraging participation by engineers in the establishment of common international markets, and creation of a committee to study professional licencing and registration requirements among the UPADI nations.

In addition, a resolution adopted at the conference called for a committee whose purpose is to encourage establishment of general engineering libraries in nations south of the United States that would be comparable to the Engineering Societies Library in New York.

NATIONAL RESEARCH COUNCIL. ASME's representative on the National Research Council reports that the Division of Engineering and Industrial Research discussed, during the year, opportunities for organizing and encouraging engineering research in new fields. In particular, attention was given to the need for a broad program of urban research.



In September, the Council accepted, "with sincere regret but with congratulations" the resignation of T. A. Marshall, Jr., Senior Assistant Secretary. Mr. Marshall has accepted the position of Executive Secretary for the American Society for Testing Materials.

EDUCATION. Engineering education, an area of critical concern, came in for attention at the Fourth Biennial Engineering Education Conference of The American Society of Mechanical Engineers and the Engineering Institute of Canada, held in Montreal, October 5–6, 1960. The theme, entitled, "The Engineer in 2000 A.D.—How Much Science in His Education?" was developed through panel presentations and interest discussions by the more than one hundred and thirty participants representing both industry and education.

The tendency in recent years has been to incorporate more basic and engineering science in engineering curricula. The consensus of those expressing their views was that this trend is valuable and helps to provide an adequate educational experience. It is useful to graduates contemplating further formal study as well as to the vast numbers who immediately launch professional careers in industry. It was also evident, however, that the conference delegates felt there must be a distinction made by all concerned, between curricula for individuals whose interests are in the realm of science as such, and for engineering students whose purpose is to convert the concepts of science into useful devices for the benefit of mankind.

LECTURERS. Each year, to carry out the Society's program of carrying up-to-date technical information to every corner of the nation, a team of lecturers is chosen from the ranks of experts in various fields. Available to Sections and Student Sections on request, these men volunteer their services in an outstanding program to service the engineering profession.

This year's lecturers and their topics were:

Dr. Samuel B. Batdorf
Electronics & Avionics Div.
Lockheed Aircraft Corp.
6201 E. Randolph Street
Los Angeles 22, Calif.
Topic: *Some Problems of Space Navigation*

Dr. Kenneth E. Bisshopp
Professor of Mechanical Engineering and Head of Department
Rensselaer Polytechnic Institute
Troy, New York
Topic: *VIBRATION THEORY—Some Applications to Problems of Mechanical Engineering*

Mr. Renato Contini
Senior Research Scientist
New York University
College of Engineering
University Heights
New York, New York
Topic: *Human Survival in Space or Human Factors to be Considered in Design Problems*

Dr. Robert C. Dean, Jr.
Head of Advanced Engineering Department
Ingersoll-Rand Company
Phillipsburg, N. J.
Topic: *More Than An Art: More Than A Science*

Dr. Harold M. Faigenbaum
Associate Head, Department of Chemistry; and Professor of Inorganic Chemistry
Walker Laboratory
Rensselaer Polytechnic Institute
Troy, New York
Topic: *Chemistry in Mechanical Engineering*

Dr. Nicholas J. Hoff
Head, Division of Aeronautical Engineering
Stanford University
Stanford, Calif.
Topic: *TEMPERATURE AND TIME—Two Parameters of Increasing Importance in the Design of Structures and Machinery*

Mr. William Littlewood
Vice President, Equipment Research
American Airlines
Washington, D. C.
Topic: *Programs and Progress in Air Transport Development*

Admiral Andrew I. McKee
Rear Admiral, U.S.N. (Retired)
Vice President and Director of Research and Design
General Dynamics Corporation-Electric Boat Division
Groton, Connecticut
Topic: *USS SQUALUS—Rescue and Salvage Operations*

Dr. Maynard M. Miller
Geology Department
Michigan State University
East Lansing, Michigan
Topic: *Man, Glaciers, and Climate*

Dr. Dwayne Orton
Editor, THINK, and Educational Consultant
International Business Machines Corporation
New York, New York
Topic: *Tomorrow's Managers or American Know-Why*

Mr. Allison K. Simons
Director of Research and Engineering
Bostrom Corporation
Milwaukee, Wisconsin
Topic: *Human Factors in Engineering Design*

PUBLIC RELATIONS. Public Relations activities of ASME during the year became more diversified. In addition to continuing programs of providing information on Society activities to newspapers, magazines, and other news outlets, the Society undertook a program of improved communications within the engineering profession. To some extent, this consisted of expanded programs of cooperation with joint bodies such as Engineers Joint Council, United Engineering Trustees, and Engineer's Council for Professional Development, as well as expanded cooperation with sister engineering societies, including those

with which ASME co-sponsors meetings and conferences. Through such cooperative programs, and the resultant multiplication of effect, it is hoped that the groundwork will be laid for a greater future appreciation by the general public of engineers and engineering. Many sections, this year, elected to participate with the National Society of Professional Engineers in publicizing "Engineers Week," devoted to calling attention of the American public to the contributions of engineers.

The objectives of ASME's public relations program continue to be to encourage a greater public understanding and appreciation of ASME, its members, and their work, and of the engineering profession at large. Distribution of the ASME motion picture, "To Enrich Mankind," continued during the year bringing the total estimated audience since the film was produced in 1955 to approximately sixteen million persons.

A number of public relations programs were undertaken or continued by professional divisions and sections of the Society. These included not only publicity concerning activities of the section or division, but public service projects, such as counseling of high school students, sponsorship of programs aimed at encouraging interest by youngsters in mathematics and science, and other worthwhile efforts which improve public knowledge, both of the activities of ASME and of the broader aspects of engineering.

THE WOMEN'S AUXILIARY. Women in the immediate family of an ASME member of any grade, are eligible for membership in the Women's Auxiliary. Membership of the Auxiliary this year passed the 2,000 mark and the number of sections grew to twenty-nine, with the addition of Ontario, Canada.

A total of four scholarships administered by the Women's Auxiliary were awarded during the year, including the Calvin W. Rice Memorial Scholarship of $1,500, given to a foreign student for graduate study in the United States. This year it was won by Mr. Benami Grobman of Lima, Peru, to help finance his study at the University of Illinois. Other awards were the Marjorie Roy Rothermel Scholarship of $750 to Andrew M. Jackson, a graduate student at Virginia Polytechnic Institute, and two Sylvia W. Farney Scholarships of $500 each to William B. Walkup, a student at the University of South Carolina and Kenneth G. Harstad at the University of North Dakota.

Loans made by the Auxiliary increased from a total of $18,000 outstanding last year to nearly $25,000 this year.

In addition to its work in support of education the Auxiliary continued its program of social events, both independently and in connection with meetings and conferences of the Society.

INSURANCE. The Group Disability Insurance Program available to ASME members completed its second successful year on June 1, 1960. Members have shown their appreciation of the value of this program by increasing their total premium payments to over $300,000 annually. Information concerning the program may be obtained from The Administrator, Insurance Program for ASME Members, 910 17th St. N.W., Washington 6, D. C.

ENGINEERS JOINT COUNCIL. As a charter member of Engineers Joint Council, a federation of 21 engineering societies, ASME continued strong support during the past year, to the Council's program of advancing the engineering profession on a broad front.

Since it was founded in 1945, EJC has had as its objective, ". . . To advance the general welfare of mankind through the resources and creative abilities of the engineering profession by promoting cooperation among the various branches of engineering."

During the year, EJC:

. . . Launched *Engineer*, a quarterly newspaper mailed to all members of EJC societies, including ASME.

. . . Sponsored the 1960 Nuclear Congress, held in New York City, which ASME aided with staff support.

. . . Administered a program to bring outstanding European engineers to the United States for lecture tours of colleges and universities, under National Science Foundation sponsorship. A specialist in Mechanical Engineering will be invited by ASME during the 1960–61 academic year.

Two ASME members, James N. Landis (left) and Willis F. Thompson, have been named as presidents, respectively, of Engineers Joint Council and United Engineering Trustees.

ASME also continued its active participation in the Committee processes of the Council, including:

. . . An *Engineering Research Committee*, 13 nationally prominent engineers studying problems related to human wants and needs and how engineers can contribute to their solution.

. . . The *Engineering Manpower Commission* of EJC—a standing Committee with professional executive staff, which develops and implements policies and procedures toward establishing the importance of engineering to the national economy. The Commission also prepares the biennial engineering survey.

. . . *Engineering Information Service*—a committee concerned with the critical field of translating, abstracting, indexing, and disseminating engineering information from all parts of the world.

ENGINEERS' COUNCIL FOR PROFESSIONAL DEVELOPMENT. For twenty eight years, Engineers' Council for Professional Development, of which ASME is a member, has continued its programs of inspection and accreditation of engineering curricula and distribution of guidance information to young people. In addition, the Council has distributed literature to young engineers, designed to acquaint them with the profession upon which they are embarking and to encourage professional attitudes. In 1960, ECPD completed preparation of, and began distribution of, a new booklet titled, "Need Financial Aid for College?" It is designed to provide basic factual information on the subject to youngsters of college age. In general, the Council reports, its guidance activities, "have been expanded in such a way, that more schools were contacted, more students advised, and more engineers participated," than ever before.

The Council completed two mailings during the year to 30,000 high schools. They included copies of the council's booklets, "After High School, What?," and information explaining how schools can request speakers and other counseling assistance from state ECPD chairmen. In addition, the mailings included current lists of ECPD-accredited curricula in engineering colleges and technical institutes. Mailing lists also went to directors of 485 institutions with an estimated enrollment of 16,000 mathematics and science teachers, and 3,800 guidance counselors.

ECPD's Education and Accreditation Committee completed the evaluation of 390 curricula in 86 institutions. One of the most potentially significant activities of ECPD was carried out by its Student Development Committee. For some years, engineers and educators have considered the desirability of instituting in the United States, some ritual signalizing the change of status of a young man from student to full fledged engineer. A similar practice has long been carried out successfully in Canada. During 1960, the committee surveyed 115 engineering colleges attempting to get a consensus on this project. Since a preponderance of deans and others contacted said they believe a ritual would be desirable, further discussion is scheduled by ECPD.

UNITED ENGINEERING TRUSTEES. United Engineering Trustees, in addition to its responsibilities as owner of the existing Engineering Societies Building and the new United Engineering Center, described elsewhere in detail, continued its other responsibilities in the operation of the Engineering Societies Library, administration of the John Fritz and Daniel Guggenheim medals, and operation of the Engineering Foundation. ASME, as one of the five Founder Societies which constitute UET, shares in this work.

Willis F. Thompson, former Vice President of ASME, and long-time representative on the Real Estate Committee of United Engineering Trustees has been named UET president for 1960.

CANADA. As in the past, ASME continued its program of cooperation with the Engineering Institute of Canada. In addition to the conference on education noted elsewhere in this report, the Society made plans for co-sponsoring a conference on hydraulics with EIC in Montreal in May 1961. In addition, the Production Engineering Division will hold a conference in Toronto, also in May 1961, in cooperation with the Ontario section.

COOPERATION. As in the past, ASME continued its program of cooperating with engineering societies and related organizations in this country and abroad. Besides those mentioned elsewhere in this report were:

American Association for the Advancement of Science
American Institute of Architects (Joint Committee of the Design Profession)
American Sanitary Engineering Inter-Society Board, Inc.
American Standards Association
Building Officials Conference of America, Inc.
U. S. Bureau of Standards
Council for International Progress in Management (USA, Inc.)
National Bureau of Engineering Registration
National Safety Council
International Institute of Refrigeration
U. S. National Committee on Theoretical and Applied Mechanics
U. S. National Committee of the International Electrochemical Commission.

UNITED ENGINEERING CENTER

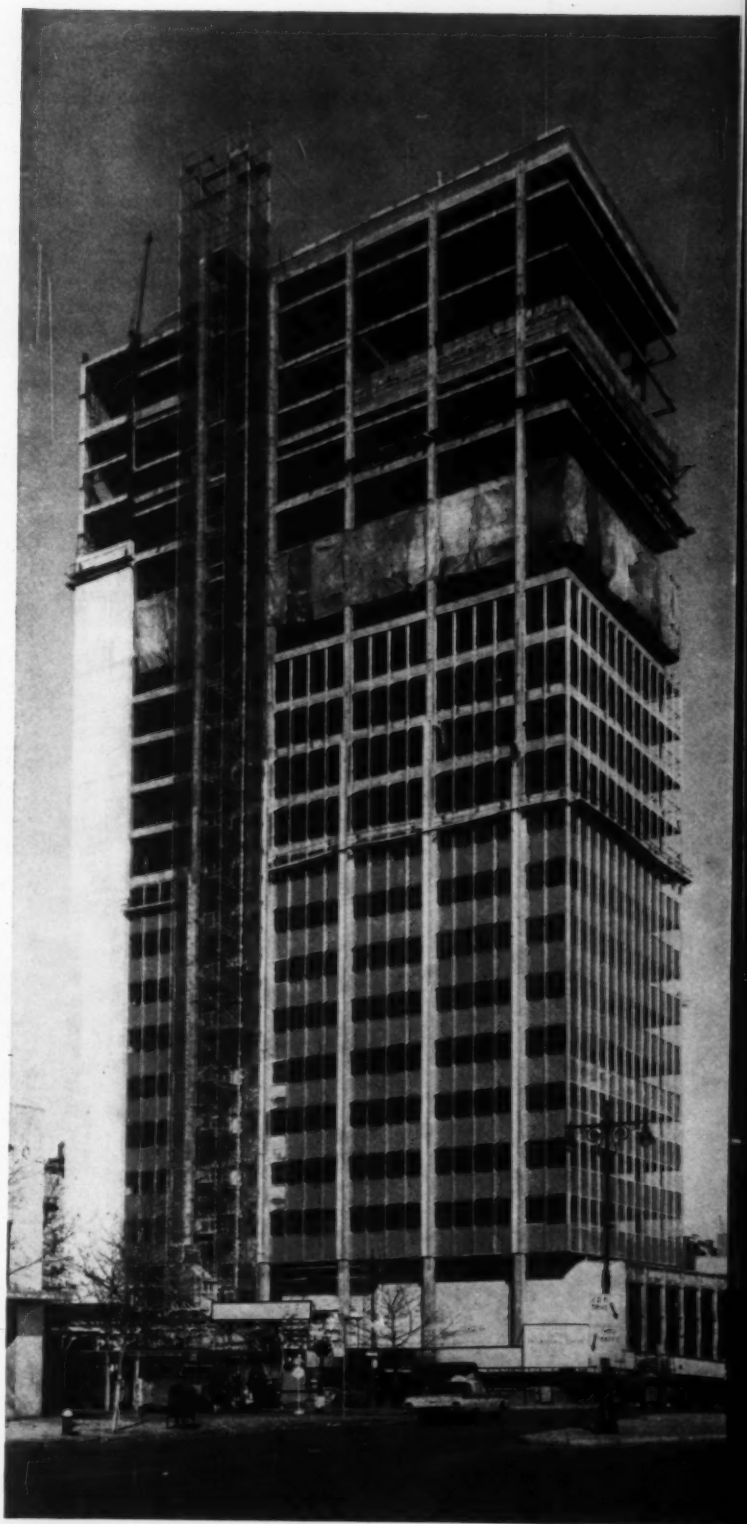
The United Engineering Center, long dreamed of as a modern home for the American engineering profession, will soon be a reality. As this report is written, construction is more than 50% complete. One day in the Fall of 1961, Headquarters Offices of ASME will be moved from the 55 year old structure in which they are now housed, to modern space at the Center.

The immediate result will be elimination of present overcrowding, substitution of comfortable, functional meeting rooms for present makeshift ones and a substantial improvement in office efficiency.

Facilities that will be available for the first time include high speed automatic elevators; central air conditioning with zoned temperature control that will not only maintain comfort, but filter incoming air for cleanliness; extra "overflow" conference rooms for committees and other groups; certain centralized facilities and services shared by several societies; and modern housing of the Engineering Societies Library, the largest such technical library in the world.

The American Society of Mechanical Engineers will occupy the fifth, sixth, and seventh floors. In addition to office space, there will be a reception area, Council Room, three other conference rooms, and publication sales facilities. Much work has been done through the year on selection of appropriate furnishings, fixtures, and equipment including data processing equipment. Selection of this particular equipment required a full scale study to assure adequacy and flexibility. Its use will simplify and speed record-keeping for purpose of accounting, maintaining membership records and lists, and other vital records. It will also make available more statistical data and information and thus provide increased service to the membership.

Interior decor will vary in detail from floor to floor with a common motif of functional arrangement combined with comfort and good appearance.



Very substantial progress during the last 12 months on the United Engineering Center heartened members and others who have long looked forward to this structure. After groundbreaking ceremonies on October 1, 1959, work began in earnest. The $12,000,000 project, 18 stories high, now stands more than half finished opposite the United Nations in New York. Final occupancy by 18 societies is scheduled for mid 1961.

ASME FINANCES

Once again in 1960, ASME came close to its objective, as a non-profit organization, of balancing income and expense. End of year totals show income exceeded expenditures by only $385, although total transactions exceeded $2.3 millions.

The Finance Committee noted in its report to the Council successful efforts to cut office expenses for the year despite a general increase in costs. This gratifying reduction, without impairing service to members, was made possible by new, more efficient techniques, improved purchasing procedures, and constant cost consciousness.

Although income from the sale of advertising, primarily in *Mechanical Engineering*, declined during the year, this loss was partially offset by increased income from the sale of publications. Increased promotional effort, begun toward the end of the year, is expected to reverse the downward trend of advertising income.

As in the past, the financial operations of the Society were guided by the Finance Committee with the aid of investment counsel. The detailed report of the Finance Committee, from which the information in this section is excerpted, is available to Society members on request. The certified report of the auditors, Price Waterhouse & Co., is on file in the Society's office and is available for inspection by ASME members.

INCOME AND EXPENSE 1959-1960

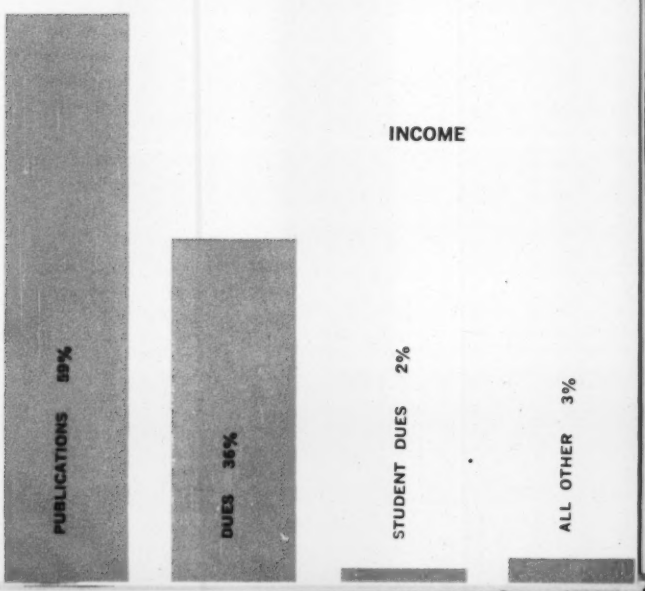
THIS IS WHERE THE MONEY CAME FROM

Publications	$1,346,796
Membership Dues	819,008
Student Dues	57,785
Research Reports	8,742
Meetings (non-member registration fees)	4,240
Miscellaneous (including interest)	64,648
Total	$2,301,219

THIS IS WHERE THE MONEY WENT

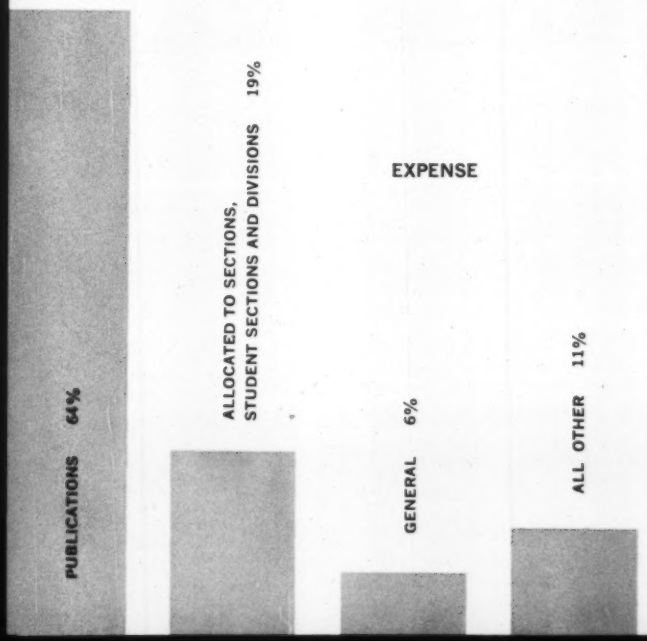
Publications	$1,478,167
Sections	202,370
Student Sections	133,943
Divisions	89,484
Meetings	67,132
General (Council, Retirement Fund, Office Service)	134,022
Admissions and Membership Development	44,916
Joint Activities*	73,080
Research Administration**	16,161
Awards	11,432
Public Relations	37,200
Miscellaneous	12,927
Set aside for reserve	385
Total	$2,301,219

* Includes $32,383 for direct and indirect support of the Engineering Societies Library.
** In addition, over $100,000.00 from custodian funds were expended on research.



BALANCE SHEET

On September 30, 1960, the Society owed:		
(1) Federal and state income taxes withheld from employees.		$ 15,650
(2) Accounts and deposits payable.		47,200
(3) Obligations for printing and distributing the 1961 Mechanical Catalog, bills for which have not been submitted.		18,047
(4) Unexpended appropriations for future services and outstanding obligations for which invoices have not been received.		168,659
(5) Future services to members who have prepaid dues.		365,313
(6) Subscriptions paid in advance.		14,862
	Total	$ 629,731
To meet these debts the Society had:		
(1) Cash in the bank.		$ 231,331
(2) Short Term U. S. Government Securities.		294,469
(3) Accounts Receivable.		167,992
(4) Inventories of publications and supplies conservatively valued.		163,932
(5) Securities at Cost.		1,197,970
(6) Deferred expenses applicable to subsequent year.		5,604
	Total	$2,061,298
The difference between the value held by the Society of $2,061,298 and debts of $629,731 is the net worth of the Society on September 30, 1960.		$1,431,567
Against this, the Society has set aside a General Reserve against contingencies.		1,000,000
THE SOCIETY ADMINISTERS A NUMBER OF SPECIAL FUNDS:		
Custodian and Development Funds:		$ 547,183
Employees Retirement Fund:		198,977
Award Funds:		330,655
	Total	$1,076,815
AGAINST THESE THE SOCIETY HAD:		
Cash.		$ 149,647
Securities (at cost).		736,905
Short Term U.S. Government Securities.		180,449
Notes Receivable.		9,814
	Total	$1,076,815
The Engineering Societies Building is owned jointly by the Founder Societies through United Engineering Trustees, Inc. ASME interest and other long-term assets are treated as a fully reserved fund.		
PROPERTY FUND OF:		$ 647,779
WITH THESE ASSETS TO SUPPORT IT:		
ASME quarter interest in real estate and certain other assets of United Engineering Trustees, Inc., 29 West 39th Street, New York, N. Y.		$ 498,448
Office Furniture and fixtures (depreciated value).		149,330
Engineering Index, Inc., Title and good will.		1
	Total	$ 647,779

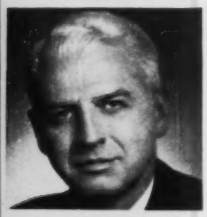


THE EXECUTIVE COMMITTEE

Walker L. Cisler
President

Thomas J. Dolan
Vice-President

William H. Larkin
Director



Henry N. Muller
Vice-President

Ronald B. Smith
Director

O. B. Schier, II
Secretary

THE COUNCIL

Decisions on matters of policy are made by the Council of ASME. This group of officers, during 1960, was composed of the President, three immediate past presidents, eight Vice Presidents, and ten Directors. Next year, as a result of the increase in number of Regions, the number of Vice Presidents will increase to ten.

Normally, the entire Council meets twice each year, at the Winter Annual Meeting and the Summer Annual Meeting. Between these full scale meetings, an Executive Committee consisting of five voting members meets monthly with the Secretary to carry on the daily business of the Society.

For advice and information, the Council and Executive Committee rely heavily on Standing Committees dealing with Finance, Organization, Professional Practice and Constitution and By Laws, and Boards on Technology, Membership, Education, Inter-Society Relations, Honors, Public Affairs and Codes and Standards.

MEMBERS OF THE COUNCIL 1960

President
Walker L. Cisler

Past-Presidents
James N. Landis
William F. Ryan
Glenn B. Warren

Vice-Presidents
Charles H. Coogan, Jr.
Thomas J. Dolan
Harold Grasse
Gordon R. Hahn
William C. Heath
John W. Little
Donald E. Marlowe
Henry N. Muller

Directors
Everett M. Barber
Elmer O. Bergman
Clarence C. Franck, Sr.
Richard G. Folsom
Eugene W. Jacobson
William H. Larkin
Arthur M. Perrin
Louis N. Rowley
Ronald B. Smith
V. Weaver Smith

MEMBERS OF THE COUNCIL 1961–1962*

President:
William H. Byrne

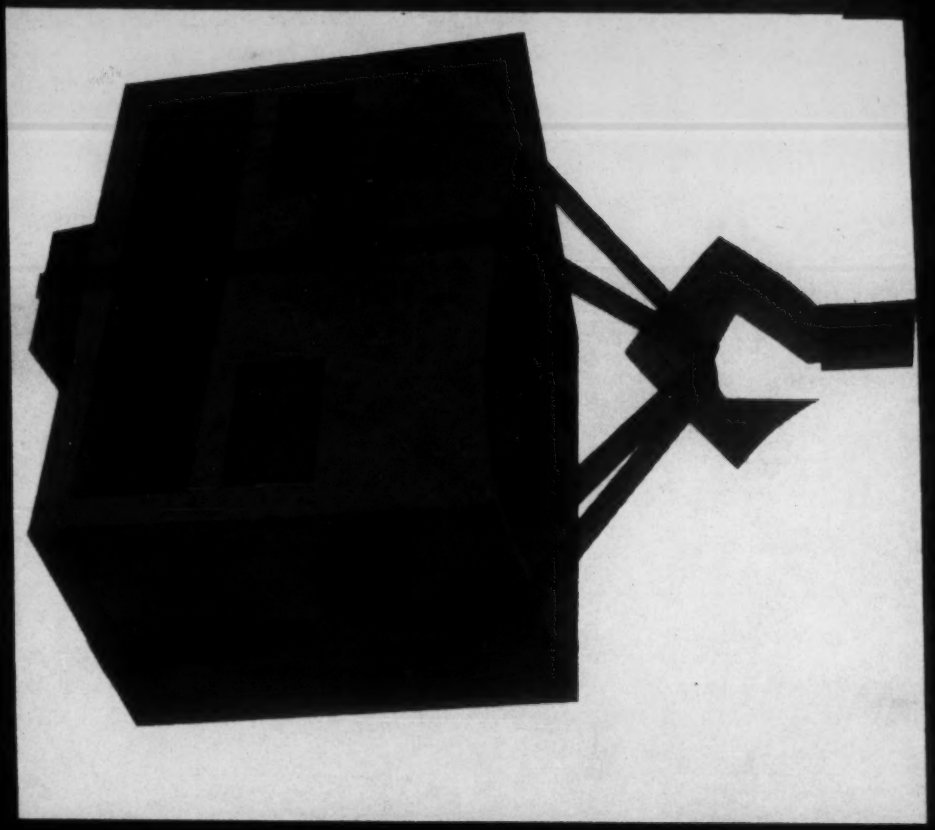
Past-Presidents
Walker L. Cisler
James N. Landis
Glenn B. Warren

Vice-Presidents
Donald J. Bergman
Charles H. Coogan, Jr.
Eaton H. Draper
Harold Grasse
William C. Heath
Allen H. Jensen
Donald E. Marlowe
Henry N. Muller
Roy C. Robertson
George B. Thom

Directors
Everett M. Barber
Elmer O. Bergman
Richard G. Folsom
Clarence C. Franck, Sr.
James B. Jones
William H. Larkin
Arthur M. Perrin
Louis N. Rowley
Ronald B. Smith
Rolland S. Stover

Treasurer
Edgar J. Kates

Asst. Treasurer
Harry J. Bauer

Secretary
O. B. Schier, II

* Due to change in administrative year this Council will continue in office until June 11, 1962.